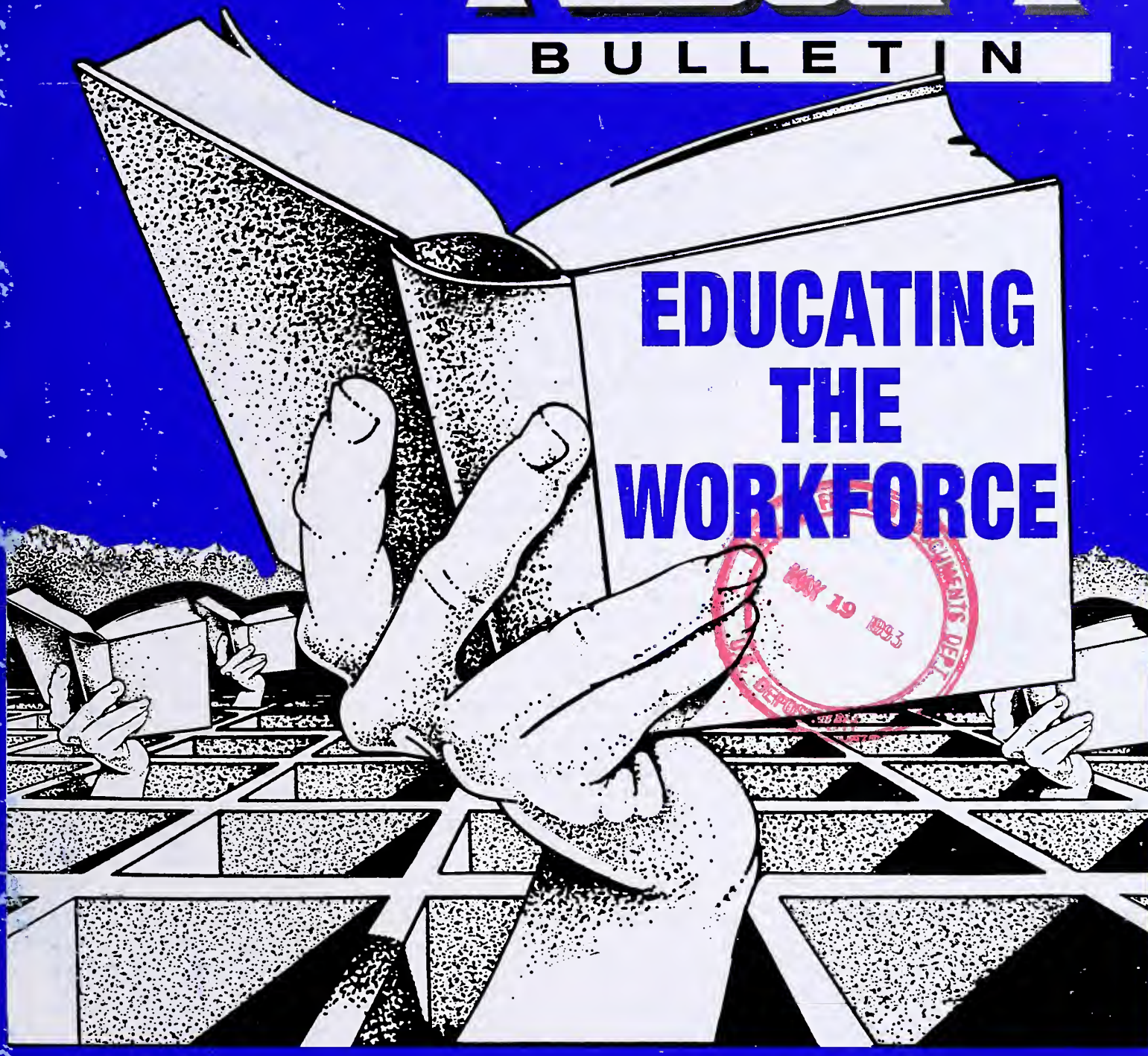
D101.52/3:
993/2

Headquarters Department of the Army
PB-70-93-2

MARCH-APRIL 1993

ARMY RD&A BULLETIN



EDUCATING THE WORKFORCE

MAY 19 1993

- DEFENSE ACQUISITION UNIVERSITY
- ARMY LOGISTICS MANAGEMENT COLLEGE
- ARMY MANAGEMENT ENGINEERING COLLEGE
- HISTORICALLY BLACK COLLEGES & UNIVERSITIES

Approved for public release: Distribution is unlimited

MARCH–APRIL 1993
PB 70-93-2

Acting Assistant Secretary of the Army (Research, Development and Acquisition)
GEORGE E. DAUSMAN

Commanding General U.S. Army Materiel Command
GEN JIMMY D. ROSS

EDITORIAL ADVISORY BOARD MEMBERS

GEORGE E. DAUSMAN
Acting Chairman, Editorial Advisory Board

LTG WILLIAM H. FORSTER
Director of Acquisition Career Management

LTG LEO J. PIGATY
Deputy Commanding General U.S. Army Materiel Command

MG FRED A. GORDEN
Assistant DCSPER

MG RICHARD T. TRAVIS
Commanding General U.S. Army Medical R&D Command

GEORGE T. SINGLEY, III
Deputy Assistant Secretary for Research & Technology Office of the ASA(RDA)

DR. ROBERT B. OSWALD
Director of R&D U.S. Army Corps of Engineers

HARVEY L. BLEICHER
Editor-in-Chief Executive Secretary Editorial Advisory Board

EDITORIAL STAFF

HARVEY L. BLEICHER
Editor-in-Chief

MELODY B. RATKUS
Managing Editor

DEBRA L. FISCHER
Assistant Editor

Army RD&A Bulletin (ISSN 0892-8657) is published bimonthly by the Army Acquisition Corps Proponency Office. Articles reflect views of the authors and should not be interpreted as official opinion of the Department of the Army or any branch, command, or agency of the Army. The purpose is to instruct members of the RD&A community relative to RD&A processes, procedures, techniques and management philosophy and to disseminate other information pertinent to the professional development of the RD&A community. Private subscriptions and rates are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or (202)783-3238. Second class official postage paid at Fort Belvoir, VA and additional offices. POSTMASTER: Send address changes to Editor, *Army RD&A Bulletin*, Building 201, Stop 889, Fort Belvoir, VA 22060-5889. Articles may be reprinted if credit is given to *Army RD&A Bulletin* and the author. Unless otherwise indicated, all photographs are from U.S. Army sources. Approved for public release; Distribution is unlimited.

This medium is approved for the official dissemination of material designed to keep individuals within the Army knowledgeable of current and emerging developments within their areas of expertise for the purpose of enhancing their professional development.

By order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the Secretary of the Army
03497

Research Development Acquisition

ARMY RD&A BULLETIN

Professional Bulletin of the RD&A Community

FEATURES

The Defense Acquisition University
Frank Sobieszczyk 1
The U.S. Army Logistics Management College
LTC Daniel D. Ziomek and Carolyn Jones 4
The Army Management Engineering College
Mike Swim, Paul Wagner and Hope A. Gardina 7
Army Plays Major Role In Supporting Black Colleges and Minority Institutions
Dr. Josie Scales and Catherine Kominos 11
Welding of Composite Materials
Diane S. Kukich 14
The Army Materiel Command's New Approach to Planning
Cynthia L. Tootle 17
Tri-Service Reliance in Aviation Test and Evaluation
COL Joseph L. Bergantz 19
Protecting the U.S. Technology Lead
CPT Robert A. Newton 21
U.S. Army Test and Evaluation Command: Supporting International Cooperative Efforts
Jeffrey L. Pierson 24
Power Technology Demonstrators for the Future Land Warrior
Selma Nawrocki and Eleanor Raskovich 26
Combat Vehicle Test Bed to Play Key R&D Role
George Taylor 30
Teaming Produces Results
Donald J. Palughi 33
Distributed Interactive Simulation—A Preview
George T. Singley III 35
Battelle Forecasts $162 Billion for U.S. R&D in 1993 40
Army Data Dictionary Technology
SSGT T. Anthony Bell 43

DEPARTMENTS

RD&A News Briefs 44
Speaking Out 46
Career Development Update 48
From Industry 52
Conferences 53
Awards 53
Letters 53
Book Reviews 54

COVER

Education and training are fundamental elements in development of the Army's professional cadre of acquisition specialists. Featured in this issue of the bulletin are articles on the Defense Acquisition University, the Army Logistics Management College, the Army Management Engineering College, and black colleges and minority institutions.

D101.52/3:993/2



THE DEFENSE ACQUISITION UNIVERSITY

By Frank Sobieszczyk

Introduction

The Defense Acquisition Workforce Improvement Act (DAWIA) of 1990 created the Defense Acquisition University (DAU) to serve as the DOD center for acquisition education, training, research, and publication. Establishing the DAU was one of the central propositions of the DAWIA, intended to unite the existing acquisition training and education activities of the military departments and defense agencies.

The president of the university reports to the under secretary of defense for acquisition (USD(A)). A council composed of senior DOD officials and chaired by the under secretary of defense for acquisition will provide policy and operations oversight for university activities.

Officially dedicated on Oct. 28, 1992, by the under secretary of defense for acquisition, the DAU is located in Alexandria, VA with Gerald E. Keightley as executive director.

A Consortium

In what seems likely to be a model for training and education in other government career fields, the DAU is structured as an educational consortium. The consortium structure builds upon the strengths of existing schools and provides the flexibility to include other institutions, as needed, to meet new or specialized needs of career acquisition professionals. Sixteen Army, Navy, Air Force, National Defense University and Defense Logistics Agency schools and activities are currently DAU members. Each consortium member retains its current organizational affiliation, with its relationship to the DAU consortium governed by a memorandum of agreement.

Consortium members develop and deliver DAU courses, and provide other university services such as performing research and publishing on acquisition-related matters. The president and a small staff coordinate and tailor DAU educational offerings to the needs of the career personnel serving in DOD acquisition positions.

The DAU is responsible for planning and directing university operations to ensure that a coherent framework of quality education and training exists for acquisition positions ranging from basic, through intermediate, to senior level. The DAU sponsors only defense wide or "purple" courses.

The DAU suballocates funds to consortium members for course development and presentation, as well as for faculty and staff salaries. Relative to student attendance, the DAU also allocates funds to the directors for acquisition career management (DACM) in each of the military departments and in the Office of the Secretary of Defense. The DAU tracks budget execution and analyzes use of funds to ensure timely and appropriate execution.

In FY 1993, more than 27,600 students are expected to attend 944 class sessions of 49 different DAU mandatory acquisition courses.

Curriculum

The DAU curriculum focuses on career training necessary for certification and membership in the Acquisition Corps, as established by the DAWIA. Offerings range from basic courses, such as the two-week "Management of Defense Acquisition Contracts," provided

DAU CONSORTIUM MEMBERS

- Air Force Institute of Technology
- Army Logistics Management College
- Army Management Engineering College
- Defense Contract Audit Institute
- DLA Civilian Personnel Service Support Office
- Defense Systems Management College
- European Command Acquisition Training Office
- Industrial College of the Armed Forces
- Information Resources Management College
- Lowry Technical Training Center
- Navy Acquisition Management Training Office
- Naval Facilities Contracts Training Center
- Naval Postgraduate School
- Naval Supply Systems Command Regional Contracting Centers
- Naval Warfare Assessment Center
- Office of the Assistant Secretary of the Navy/RD&A/APIA-PP

by several DAU schools, to the 20-week Program Management Course at the Defense Systems Management College and the Senior Acquisition Course taught at the Industrial College of the Armed Forces. Course lengths range from a few days to several months and are provided at sites worldwide, throughout the year.

In addition to providing resident instruction and instructors to travel to local facilities, the university provides other innovative learning opportunities, including satellite instruction, video tutorials, and correspondence courses.

The annual Defense Acquisition University catalog describes mandatory courses for selected functional areas and requirements for advancement in specific career fields. Courses are grouped by career field and career levels. The catalog also provides information on DAU consortium members and points of contact for course quota management. Course descriptions, prerequisites and course sponsors are addressed individually and are grouped by provider and location. A complete schedule of offerings, with dates, locations and quota allocations for each class, is published separately. Both the catalog and schedule are available through personnel offices.

Competency-Based Courses

All DAU mandatory acquisition courses are competency-based. A competency defines the knowledge, skills, and abilities needed to perform a duty to a specific level. The Defense Acquisition Workforce Improvement Act and the Office of Federal Procurement Policy Letter 92-3 dated June 24, 1992, directed the Department of Defense to provide acquisition workforce training based on the duties and competency levels required in its acquisition positions.

Seven DOD career management boards have been convened to determine what competencies are needed at each career point in positions in the functional areas. The DAU participates in each of the seven career boards and their various working groups, helping them determine functional area competencies for each career field. Establishing and maintaining course curricula to support training of these competencies is another of the DAU's primary academic responsibilities.

Having determined the need for a mandatory course, it becomes the DAU's responsibility to select sponsors for these courses and to identify standard processes and procedures for their development. The DAU also identifies the standard methods for delivering the course, including programs of instruction, instructor guides, exercises and examinations, and other course materials.

Certified Course Offerors

Only certified course offerors may present DAU mandatory courses. A certified course offeror is an organization or activity that has been approved by the DAU as having the appropriate resources (trained instructors, facilities, course materials, etc.) and quality standards required to conduct a mandatory course developed by a DAU course sponsor. This certification requirement assures that a high level of quality is maintained and that the courses are indeed "purple." As further quality control, the DAU will review mandatory courses on a regular basis for accuracy and quality of course materials and instruction.

Career Management Directors

In developing and delivering training and education to the defense acquisition workforce, the DAU must work closely with other organizations that ultimately control the DAU's total workload. As required by the DAWIA, four directors of acquisition career management (DACMs) have been established, one in each of the military

departments and one for the defense agencies and organizations outside of the military departments.

DACMs are responsible for managing career development for all acquisition workforce personnel under their purview. They determine which positions are in the workforce and in the Acquisition Corps, and which individuals need training to meet requirements for certification or advancement in their career field.

Virtually all questions regarding people and positions in the defense acquisition workforce should be directed to the DACMs. The DACMs provide estimates to the DAU of their total training requirements for each mandatory acquisition course. These estimates, together with capacity estimates from the DAU consortium members and estimates of available financial resources, are worked into a schedule of class offerings for the next fiscal year. The schedule is published three months before the start of the fiscal year, at which point the DACMs begin the process of identifying and assigning students for each of the classroom seats that have been provided to them.

The DACMs are responsible for ensuring that qualified students are assigned to the allocated quotas. A qualified student is an individual in the acquisition workforce who must complete a mandatory acquisition course in order to be certified to perform the duties of the job presently occupied or to prepare for a position at the same or higher level in the acquisition workforce, depending upon service/DOD agency needs.

Training Requirements and Resources

The Army Training Requirements and Resources Systems (ATRRS) is the DAU's centralized reservation system for ensuring that students are placed in the mandatory courses. Any class seat may be reserved as soon as it is established in the ATRRS. Supervisors and their workforce personnel who need training will find it to their benefit to identify their requirements to their DACMs as early as possible.

Course Equivalencies

Not every individual currently in the workforce will have to physically attend all of the required courses. Several alternatives have been developed to acquire certification for completion of a DAU course.

Courses offered by DOD components, other government agencies, or universities and colleges will be reviewed by the DAU in coordination with functional experts, consortium schools, the Federal Acquisition Institute (FAI), and other agencies as appropriate to determine equivalency to a DAU mandatory acquisition course. Once a course is declared equivalent, it may be used as a substitute for the DAU course.

The DAU also establishes standards and procedure for a program to grant course equivalency through testing. A DAU-led working group will review proposed course equivalency examinations for compliance with DAU standards. Approved examinations will be listed in the DAU course catalog. Successful completion of one of these tests will provide certification for the mandatory course.

Workforce members with extensive experience may obtain course certification through a fulfillment program. A table of competencies taught in each of DAU's mandatory acquisition courses will be provided to the directors of acquisition career management. The DACMs will authorize supervisors to certify employees through fulfillment if they attest that the employee has demonstrated those competencies on the job. For the 20-week Program Managers Course and the Automated Information Systems Advanced Management Program, fulfillment procedures are still being developed.

DAU courses may also be used to satisfy new standards established in DAWIA that require a minimum number of college credits in specific academic disciplines to qualify for positions in certain acquisition career fields and membership in the Acquisition Corps. One option available to acquisition workforce personnel to meet these standards is by passing approved college course equivalency examinations.

DAU funds a program managed by the Defense Activity for Non-Traditional Education Support (DANTES) to provide these examinations. Information on this program is available through designated personnel offices in the service or DOD component. Some of the mandatory acquisition courses offered by the DAU will carry college credits that may be used to satisfy the minimum requirement. College credit recommendations for DAU courses will be published in future DAU catalogs.

Scholarship Program

Providing training to the defense acquisition workforce is the primary mission of the DAU, but it is not the DAU's only job. The DAU also manages the DOD Acquisition Scholarship Program, which provides opportunities each year for outstanding college graduates to acquire master's degrees in exchange for future employment in the defense acquisition community. Information about this program can be obtained through installation and agency training offices or by writing to the Defense Acquisition Scholarship Program, Northeast Consortium for Engineering Education, 1101 Massachusetts Avenue, St. Cloud, FL 34769.

The Future

To provide for continuing improvement of the acquisition workforce, the DAU and its consortium members will continue to identify ways to enhance their programs and staff development, and examine new education technology. The DAU activities will be coordinated with other DOD components, government agencies and private organizations and institutions for exchange of information, evaluation of technologies and outreach possibilities.

To keep the DAU in the forefront of acquisition issues, the university will foster debate, examine acquisition issues and develop university faculty by supporting research, symposia, conferences and publications. It will also ensure excellence in acquisition management by providing a forum for research and publications.

For further information on how DOD is implementing the Defense Acquisition Workforce Improvement Act, which courses are mandatory for acquisition career fields, and how the defense acquisition workforce is being organized and managed, see DOD Directive 5000.52, or contact your service or agency DACM.

FRANK SOBIESZCZYK is director for university operations, Defense Acquisition University. He holds a master's of business administration from Syracuse University.

THE U.S. ARMY LOGISTICS MANAGEMENT COLLEGE: EXCELLENCE IN TRAINING THE ACQUISITION WORKFORCE

By LTC Daniel D. Ziomek and Carolyn Jones

Introduction

The U.S. Army Logistics Management College (ALMC), Fort Lee, VA, has a long rich history of training the acquisition workforce. Its origins can be traced to a 12-week Army Supply Management Course which began on July 1, 1954. The U.S. Army Logistics Center was officially established under the operational control of the Department of the Army, deputy chief of staff for logistics (DA DCSLOG) on May 1, 1956. Shortly thereafter, five new functional courses in requirements management, procurement management, distribution management, maintenance management, and property disposal management were added to the curriculum. In September 1956, the ALMC curriculum was expanded to include correspondence courses and use of accredited instructors in off-campus modes.

Logistics research and doctrine were added to the ALMC mission in 1958. In July 1962, the Department of Defense (DOD) directed that ALMC establish the Defense Logistics Studies Information Exchange which would serve as a central coordination point for logistics studies.

On Aug. 1, 1962, the U.S. Army Materiel Command (AMC) assumed command and control of the center. Under AMC's direction, ALMC placed a renewed emphasis on presentation of instruction in acquisition management, management of research and development, and on integration of life cycle management during all phases of the materiel acquisition process.

In 1969, ALMC began publishing the *Army Logistician*, a bimonthly professional bulletin. The center began teaching via television in January 1985 over the Satellite Education Network, furthering its reputation as an innovative educational institution.

Schools

ALMC assumed control of the Joint Military Packaging Training Center, Aberdeen Proving Ground, MD, on July 1, 1985. As a result, the Army Logistics Management Center had grown into four schools, which remain to this day: the School of Military Packaging Technology, the School of Materiel Readiness, the School of Logistics Science, and the School of Acquisition Management.

The mission of the School of Military Packaging Technology is to provide

logistics operators with training in the latest techniques of preservation, packaging, marking, and packing of military supplies and equipment for storage and/or transportation.

The School of Logistics Science has responsibility for training logisticians for performance at the executive level. The major disciplines covered include operations research/systems analysis, artificial intelligence, decision risk analysis, cost analysis and cost estimating, and manpower and force management.

The School of Materiel Readiness concentrates on the central areas of logistics extending from the interface with acquisition management to the end of the material life cycle. Among the subjects taught are requirements determination, inventory management, depot operations, elements of distribution and transportation management, maintenance operations, international logistics, the Army Logistics Assistance Program, and management of disposal operations.

The mission of the School of Acquisition Management is to provide training and education and, in addition, research, doctrine and consulting support to DOD in the functional areas of materiel acquisition management and contracting. Major areas of concentration include the materiel acquisition process, research and development, integrated logistics support planning, test and evaluation management, acquisition planning, contracting, procurement, and quality assurance.

AMC Permanent Orders No. 56-6, Sept. 16, 1987, redesignated the U.S. Army Logistics Management Center as the U.S. Army Logistics Management College, effective Aug. 21, 1987. Designation as a college represented a major milestone in the history of ALMC and solidified the college's reputation for excellence in acquisition and logistics training.

DAU COURSES OFFERED BY ALMC

Old ALMC Name	*New ALMC/DAU Name*
Management of Defense Acquisition Contracts (Basic)	Contracting Fundamentals: CON 101
Management of Defense Acquisition Contracts (Advanced)	Intermediate Pre-Award Contracting: CON 211
Management of Defense Acquisition Contracts (Exec)	Executive Pre-Award Contracting: CON 311
Defense Small Purchase (Basic)	Small Purchase Fundamentals: PUR 101
Defense Small Purchase (Advanced)	Executive Small Purchase: PUR 301
Defense Contracting for Information Resources	Automated Information Systems (AIS) Contracting: CON 241
Defense Contract Property Disposition	Contract Property Disposal: IND 102
DOD Acquisition Quality Assurance	Intermediate Quality Assurance: QUA 201
DOD Acquisition Quality Assurance Management	Executive Quality Assurance: QUA 301
Army Provisioning Process Course	Provisioning: LOG 303
Defense Basic Logistics Support Analysis	Logistics Support Analysis: LOG 202
Reliability Centered Maintenance	Reliability and Maintainability: LOG 301
Integrated Logistic Support (Basic)	Basic Integrated Logistic Support: LOG 101

When the Acquisition Enhancement (ACE) Program Report II was published in December 1986 by the ACE II Study Group, identifying major shortfalls in acquisition training, it was apparent that DOD would assume responsibility for ensuring that quality training was provided to the acquisition workforce. In March 1987, the assistant secretary of Defense mandated that a program be established to ensure adequate training of the acquisition workforce through competency-based instruction.

Competency-Based Instruction

Competency-based instruction is instruction that imparts knowledges and abilities needed for performance of identified job tasks at a predefined level of knowledge under specific conditions. It is based on surveying functional experts to determine the tasks which are required to perform a specific job. These tasks become the competencies for that functional area. Course material and instruction is designed to ensure that these tasks are taught at the learning level designated by the functional community.

ACE Program

The ACE Program was established to perform the mission of training the acquisition workforce. It was logical that the ACE Program Office would look to ALMC with its long history of excellence in acquisition training to help perform the mission given to them by the secretary of Defense. Seven ALMC courses were designated as ACE mandatory within the first year of the program. These first seven courses were: the Defense Small Purchase Course (DSPC) (Basic), the Management of Defense Acquisition Contracts Course (MDACC) (Basic), the Management of Defense Acquisition Contracts Course (MDACC) (Advanced), the Defense Contracting for Information Resources Course (DCIRC), the DOD Acquisition Quality Course (DODAQAC), the DOD Acquisition Quality Assurance Management Course (DODAQAMC), and the Defense Contract Property Disposition (DCPD) Course. It was soon discovered that a shortfall existed at the executive level in contracting, and ALMC was assigned a tasking through the ACE Program to develop the Management of Defense Acquisition Contracts Course (MDACC) (Executive).

ALMC's DSPC (Basic) was the first acquisition course to undergo review by a group of functional and educational experts from all three services and DOD agencies to ensure that the course was providing the competency-based instruction necessary for purchasing agents to perform their jobs. It was determined that the competencies needed to perform small purchases could not be taught in a one-week basic course and DSPC (Basic) was expanded to a two-week course. During the same workshop, it was recognized that the GS-1105 (Purchasing Agent) series represented a separate career field within DOD and would require some training above the basic level. As a result, ALMC was given the mission to develop a Defense Small Purchase Course (Advanced). By 1989, ALMC was the lead school for nine ACE mandatory courses.

The secretary of Defense's 1987 mandate for improving the acquisition workforce was formalized with the passage of Public Law 101-510, the Defense Acquisition Workforce Improvement Act (DAWIA) in November 1990. The DAWIA required that an acquisition corps be established for each service and that a Defense Acquisition University (DAU) be created to provide mandatory training to the acquisition workforce. ALMC continued to work toward becoming the center of excellence for acquisition training within DOD, and all of its contracting courses underwent competency-based functional reviews between 1989 and 1992.

The Combined Arms Support Command (CASCOM) of the U.S. Army Training and Doctrine Command (TRADOC) took operational control of ALMC on Jan. 1, 1991, with full command on Oct. 1, 1992. During its first year under CASCOM direction, ALMC produced over 5,000 ACE mandatory graduates, the largest of any school participating in the ACE Program.

Defense Acquisition University

The ACE Program transitioned into DAU which was officially inaugurated in October 1992. The DAU was established as a consortium of schools with ALMC being one of the three largest consortium members. The DAU's mission is to educate and train professionals for effective service in the defense acquisition system; to achieve more efficient and effective use of available acquisition resources by coordinating DOD acquisition education and training programs and tailoring them to support the careers of personnel in acquisition positions; and to develop education, training, research and publication capabilities in the area of acquisition. Its primary function is to serve as the principal coordinator of DOD-wide acquisition education and training functions.

During the formation of the DAU, focus on improving the acquisition workforce also turned toward acquisition logistics. Again, because of its long history in acquisition logistics training, four ALMC courses were added to the mandatory training list for this important functional area. The four ALMC courses were: the Defense Basic Logistics Support Analysis (DBLSA) Course, the Integrated Logistics Support (ILS) (Basic) Course, the Army Provisioning Process Course (APPC) and Reliability Centered Maintenance (RCM) Course. With the addition of these four courses, ALMC currently has 13 approved DAU courses (see accompanying chart).

Conclusion

Including the courses taught for the DAU, the four schools of ALMC now have a curriculum of 94 courses in acquisition management, logistics management, installation management, and in managerial and analytical skills. The college will continue to participate as a DAU member dedicated to providing quality training to the acquisition workforce. It is also our conviction that the quality training programs by ALMC will lead DOD in its quest to "Manage Our Resources Wisely."

LTC DANIEL D. ZIOMEK is the dean of the School of Acquisition Management at the Army Logistics Management College. He is a certified member of the Army Acquisition Corps.

CAROLYN JONES is the director of the Defense Acquisition University Program Office at the Army Logistics Management College. She is a GM 1101, business management specialist, and is fully qualified as a GS-1102, contract specialist.

THE ARMY MANAGEMENT ENGINEERING COLLEGE

By Mike Swim,
Paul Wagner,
and Hope A. Gardina

History

The Ordnance Management Engineering Training Program was chartered in 1952 to provide training in best business practices to civilians working for the U.S. Army Ordnance Corps. From this modest beginning, demand for the Army Management Engineering College (AMEC) services grew rapidly. Other Army technical services and Department of Defense components soon requested an opportunity to participate. As graduates returned home and applied their newly acquired knowledge, they found that situations were sometimes encountered that could not have been anticipated in the classroom. Telephone calls to their instructors for assistance were common. This eventually evolved into our current consulting mission. In addition, managers in the field requested that our instructors conduct research to identify new technology and advances in management practices that could be applied in the DOD environment. This applied research resulted in a revised curriculum and improved operations throughout DOD.

Thus, what is now known as the Army Management Engineering College evolved from a single training mission into an activity encompassing three interlocking functions: training, consulting, and applied research. Over the years, our mission and name continued to change in response to the needs of the Army Materiel Command (AMC), the Army and DOD.

The School of Engineering and Logistics, located in Texarkana, TX, joined AMEC in March 1992, and provides eight excellent AMC intern training programs in the fields of engineering and logistics.

The Information Mission Area Training Center of Excellence (IMATCE), located at Fort Ritchie, MD, was established in 1990 to serve the needs of the 7th Signal Command and other Army agencies in the specific Information Mission Area (IMA) requirements. When AMEC became the Army's Executive Agent for IMA, the commander of the 7th Signal Command recommended that IMATCE become part of AMEC. IMATCE became part of AMEC in October 1992. The IMATCE curriculum of eight courses will be enhanced with technical networking courses in FY 93.

January 1993 marked the opening of a Regional Training Center in St. Louis, MO. Courses offered in St. Louis are drawn from the breadth of the AMEC curriculum.

Mission/Vision

The mission of AMEC is to prepare today's organizations, leaders and employees for future challenges; to be the government's catalyst for improvements; to consistently exceed our customer's expectations; and to be a living, developing example of an excellent organization.

Training

The Army Management Engineering College provides training in more than 150 different courses covering a wide variety of subjects and techniques. Courses average two weeks in length, are intensive, and concentrate on practical "how to do it" information.

There is usually a diversity in the education, age, experience and work

AMEC VISION



★ *TO PREPARE TODAY'S ORGANIZATIONS, LEADERS AND EMPLOYEES FOR FUTURE CHALLENGES*

★ *TO BE THE GOVERNMENT'S CATALYST FOR IMPROVEMENTS*

★ *TO CONSISTENTLY EXCEED OUR CUSTOMER'S EXPECTATIONS*

★ *TO BE A LIVING, DEVELOPING EXAMPLE OF AN EXCELLENT ORGANIZATION*

environment of students attending a class. This provides unique opportunities to learn from the experiences of other students in addition to the information provided by the class instructor.

Research

The applied research mission is oriented towards developing new or adapting current private sector management techniques or approaches to solve problems encountered in governmental agencies. This often involves an interdisciplinary process that includes behavioral, quantitative or traditional engineering approaches. The outcome of management research is usually incorporated into the curriculum and often applied as a valuable innovation to DOD operations.

Consulting

The consulting mission requires AMEC to provide management advice and assistance to commanders and directors of AMC and other Army and DOD organizations. Consulting activities cover a wide variety of functional areas, including work system design, management systems and procedures, organizational planning, management information systems, computer technology, work productivity measurement and enhancement, engineering management and technology, quality assurance and manager development.

Mission Interrelationships

The interwoven circles of training, consulting, and research are symbolic of the interrelationship of AMEC's three major missions. College staff members perform all three functions. Experience has demonstrated that research and consulting activities significantly benefit classroom effectiveness. The practical experience gained from a consulting assignment can be transmitted with a greater degree of relevance to the learning situation. From the instructor's standpoint, the subject matter under consideration has been applied, tested and evaluated in an actual working environment. The instructor has enhanced knowledge of what is effective and useful and can teach accordingly.

Conversely, the training function has a significant influence upon the accomplishment of the research and consulting functions. To teach effectively, the instructor who is up-to-date in a subject matter area has a greater capability to apply this knowledge to existing management and organization problems during the performance of a consulting assignment.

In addition, the research function supports both the consulting and training functions since the findings of research can be applied to resolve problems encountered during a consulting assignment and/or can be used in a classroom presentation. In summary, AMEC experience has demonstrated that the effectiveness in any one of the three basic mission functions is greatly enhanced from participating in the other two functions.

Curriculum

The Army Management Engineering College constantly strives to maintain a viable curriculum that will meet the training needs of functional course proponents and users in the field. The dynamic sociological-technical environment that exists in the Department of Defense necessitates frequent changes in the curriculum. Several courses are usually added, deleted or undergo major revisions every year.

The curriculum has been designed to support a variety of training needs. There are courses designed for entry-level employees, interns, journeymen, managers and executives. These courses address enhancement of current job performance, career development and preparation for a new job assignment. AMEC's current curriculum has several types of courses including:

• **Manager Development** courses which are designed to increase the skills and abilities of managers and supervisors;

• **Orientation** courses provide attendees with basic information about a specific functional area, discipline, or topic;

• **Technique** courses are designed to add to an individual's problem solving ability or skill in a functional area; and

• **Workshops** provide a forum for experienced people from a particular functional area or discipline to share lessons learned and exchange ideas in a structured setting.

• Tailored training can be provided in a **Modular** format by customizing course materials and content to specific requests.

How AMEC is Changing

Since mid-1991, in keeping with the its vision, AMEC experienced some growth and changes. No novice to change, AMEC, in March 1992, dissolved its hierarchial management structure—reorganizing from five levels of management to two. The AMEC faculty realigned itself into six self-managed work teams. Our faculty teams include Quality and Systems Acquisition Technology, Vision Achievement, Organization Enhancement, Information Management, Operations Management, and the School of Engineering and Logistics. These work

The Army Management Engineering College constantly strives to maintain a viable curriculum that will meet the training needs of functional course proponents and users in the field.

"We Believe"

We Believe in Integrity
- ★ *Doing What is Right*
- ★ *Telling the Truth*
- ★ *Walking Our Talk*

We Believe in Teamwork
- ★ *Accepting Responsibility and Accountability*
- ★ *Empowering People and Sharing Leadership*
- ★ *Communicating Honestly and Freely*

We Believe in People
- ★ *Respect and Caring for Our Families*
- ★ *Respect and Caring for Our Customer*
- ★ *Respect and Caring for Each Other*

We Believe in Customers
- ★ *Listening to Their Needs*
- ★ *Responding Quickly*
- ★ *Exceeding Their Expectations*

We Believe in Excellence
- ★ *Delivering the Highest Quality Products and Service*
- ★ *Developing Our People*
- ★ *Being the Best in Our Business*

We Believe in Innovation
- ★ *Charting Visionary Directions*
- ★ *Facilitating Change*
- ★ *Improving Continuously*

AMEC
- ★ *Loyalty to Each Other and Our Customers*
- ★ *Dedication to Our Mission*
- ★ *Commitment to Our Vision*

teams are supported by our Executive Support Board (ESB). Representatives on the ESB provide a variety of expertise and experience that facilitates the faculty's support of AMEC's mission while serving the needs of the customer.

Quality and Systems Acquisition Technology Team

The Quality and Systems Acquisition Technology Team contributes to AMEC's value-added philosophy, offering a wide range of courses and specialized services in the areas of quality, reliability, and systems engineering.

While much of the team's curriculum is applied to weapon systems life cycles, service and software quality assurance training is also provided. Customer-driven training on a variety of topics is provided through workshops tailored to meet specific needs of organizations and individuals. Team specialists offer expertise on a wide range of topics including: Acquisition Quality Assurance, Reliability and Maintainability Technology, Applied Statistics, Computer-Aided Design, Manufacturing, and Industrial Preparedness. These specialties are offered to a broad client base encompassing the Department of Defense, other federal agencies, and their counterparts from nations throughout the world.

AMEC's Role in DAU

AMEC is one of 16 members in the Defense Acquisition University (DAU) consortium. Today, we sponsor one DAU course, AMEC-210 DOD Acquisition Quality Assurance Fundamentals, and recently became certified offerers of five other DAU courses. The ongoing re-definition of the DAU's curriculum is expected to lead to a much larger role for AMEC in the future. Now being addressed is the systems engineering community in the acquisition workforce, which has been a niche that AMEC has been serving for over 30 years. We are also supporting DAU with the detail of one of our faculty on a developmental assignment at DAU for a year. AMEC participates in DAU activities and policy establishment to the same degree as all the other members of the consortium.

AMEC Acquisition Corps Initiatives

The Quality Systems Acquisition Technology Team (QSAT) is currently playing an active role in several acquisition improvement initiatives in support of the Army Materiel Command (AMC), other Army agencies, and the Department of Defense. These initiatives involve both current and planned efforts in the areas of training and consulting. The QSAT Team is currently active in the presentation on the Department of the Army's Acquisition Improvement Workshop.

Acquisition Improvement Workshop

The Acquisition Improvement Workshop is commonly referred to as Roadshow II. The purpose of Roadshow II is to develop a cadre of leaders who will take the initiative to improve the materiel acquisition process throughout the Army acquisition community. Roadshow II provides an in-depth understanding of 15 acquisition improvement principles. The cadre can then incorporate the principles into their daily acquisition activities. The workshop is currently being presented to AMC's major subordinate commands (MSC) and other activities.

Following the completion of the Roadshow II initiative, the workshop will be transitioned to AMEC for a follow-on presentation to the MSCs and other activities. Known as Roadshow III, this initiative will further augment the cadre of acquisition leaders trained in acquisition improvement principles.

The QSAT Team has also been assigned by HQ, AMC to coordinate the development of new training courses and modification of current courses as required to support the Army acquisition improvement initiatives. These courses will include, but are not limited to, an overview of Army acquisition improvements targeted to the journeymen level, best value contracting, performance specifications, requirement identification, request for proposal preparation, and research and development initiatives.

The team is active in the consulting arena with respect to these Army acquisition improvement initiatives. Current and anticipated efforts include the establishment of a joint government-industry training program to support the initiatives, and serving as the central point-of-contact for the institutionalization of the acquisition principles.

MIKE SWIM is a faculty member on AMEC's Quality and Systems Acquisition Technology Team. He holds a B.S. degree from the University of Illinois. Having 23 years of federal service, Swim has held a variety of teaching assignments in the acquisition area, including Modern Acquisition Tools, Techniques and Methods; Value Engineering; and Multimedia Training Methods. He is also a key designer and trainer in the Acquisition Corps roadshows.

PAUL WAGNER is the deputy commandant for academic affairs and administration and also serves as AMEC's primary interface with DAU. Wagner holds an M.S. degree in industrial engineering from the Illinois Institute of Technology. He has over 25 years of federal service and has held several teaching and staff positions at AMEC.

HOPE A. GARDINA holds a staff position in the newly created Marketing Department at AMEC. Gardina came to AMEC one year ago with 13 years of sales and marketing experience from a Fortune 500 company. She is currently working on a doctoral degree in business and holds an M.B.A. degree from Eastern Kentucky University and a B.B.A. from the University of Kentucky.

ARMY PLAYS MAJOR ROLE IN SUPPORTING BLACK COLLEGES AND MINORITY INSTITUTIONS

By Dr. Josie Scales
and Catherine Kominos

Introduction

Studies by the National Science Foundation and the National Academy of Sciences have indicated that in order to meet the scientific and economic challenges expected in the year 2000, the nation will need to attract and retain more students in degree completion activities in science, mathematics, and engineering (SME). Approximately 70 percent of the adults entering the workforce between now and the 21st century will be women and minorities. Yet, women and minorities are two groups historically under-represented and underutilized in science and engineering.

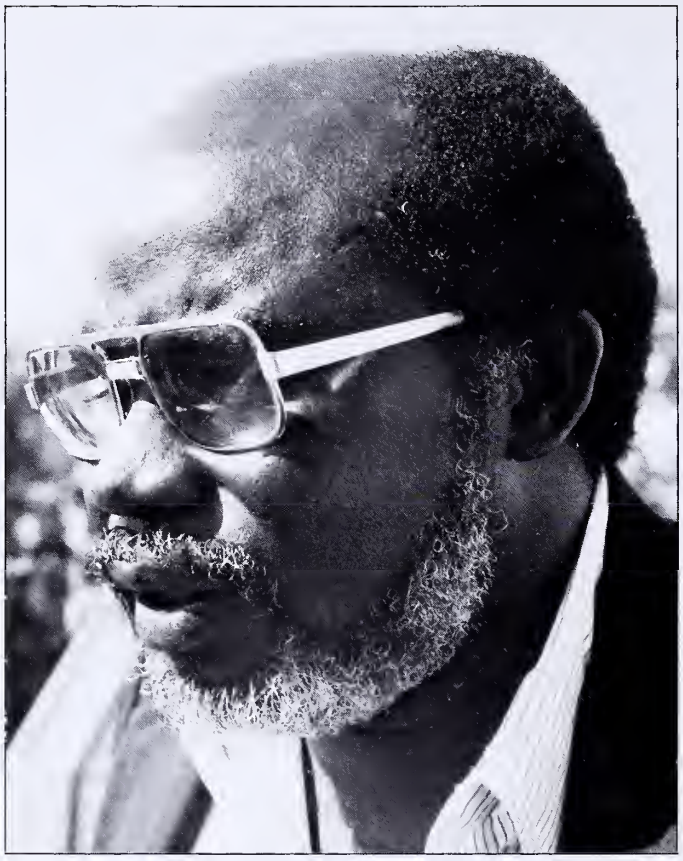
One way the nation can meet the projected shortfalls for new scientists and engineers is by utilizing the talent of those who traditionally have not been part of the technical workforce. The importance of making women and minorities more aware of the nature and potentials of pursuing technologically oriented careers is cited by the Executive Branch in the president's "America 2000" Program, by the Congress, the Department of Defense, the National Science Foundation, and the military services.

Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) contribute significantly to the pool of scientists, mathematicians, and engineers being graduated. HBCUs/MIs have produced more than 70 percent of all African-American graduates of colleges since the inception of this nation, and have motivated and produced the majority of minority military officers, engineers and scientists. In recognition of this, section 832 of Public Law 101-510 (Nov. 5, 1990), entitled "Enhancing Participation of Historically Black Colleges and Universities and Minority Institutions in Defense Research," directs the Department of Defense (DOD) to award 5 percent of all contract funds supporting research and development by institutions of higher education to HBCUs or MIs.

To achieve the 5 percent goal, DOD is directed to provide both technical assistance and infrastructure assistance to HBCU/MI institutions. The infrastructure assistance program includes:



Fountain Hall at Morris Brown College.



Dr. Tepper L. Gill, director of computational science and engineering research, Howard University.

programs in scientific disciplines; programs to assist existing faculty as well as to attract and retain new faculty in scientific disciplines critical to the national security functions of DOD; partnership programs with defense laboratories to train students in these disciplines; scholarship and fellowship programs; cooperative work-education programs; and programs to equip and renovate laboratories for the performance of defense research.

Army Support

The Army's R&D support of the nation's HBCU/MI community began in 1980 with more than $18 million of research activities at 31 institutions. Recently, the Army increased its funding of the HBCU/MI Program from $9.2 million—4.5 percent of the FY89 Army-wide university funding level—to $22 million—12.8 percent of the FY91 Army-wide university funding level. As these figures indicate, the Army has exceeded the 5 percent Congressional goal by a wide margin in the last two fiscal years.

The HBCU/MI basic research program covers all science, mathematics, and engineering of interest to the Army. The three elements of the Army approach are single investigator programs, cooperative programs, and HBCU Centers of Excellence.

Single Investigator Program

The University Single Investigator Program enables scientists and engineers to exploit unique research opportunities and to explore concepts for new, unanticipated key emerging technologies. Intensive research is conducted on specific critical research areas that are high risk and have the potential for high payoff in 2-3 years. The program is a well-established grants program that originated in FY80 at the $0.5 million level. Last year, there were 45 HBCU/MI contract awards covering chemistry, engineering, electronics, geosciences, biosciences, mathematics, materials research, and physics.

Alabama A&M is one example of an HBCU/MI which has received Army support for student employment programs, research, student stipends and professional development since the late 1960s. Through Army Missile Command support, bachelor's and master's degree programs in mathematics, and a doctoral program in physics were established at Alabama A&M. The students enrolled in these programs are able to do hands-on research on campus, at the Army Missile Command, and at other Army or federal laboratories. The Army's support was instrumental in Alabama A&M being recognized as a rapidly growing research institution.

In 1990 and 1991, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen Proving Ground, MD, funded a bioremediation project involving the removal of heavy metals (Arsenic, Cadmium and Zinc) from contaminated water using microbiology mat systems under the direction of Dr. Judith Bender, who is a research professor at Clark-Atlanta University. A follow-up project is currently being funded by the Army Waterways Experiment Station. As a direct result of this funding, Bender's bioremediation laboratory has advanced the heavy metals sequestering research to the level of a pilot field project (currently in progress).

Dr. Augusto Rodriguez, with the Department of Chemistry at Clark-Atlanta University, has been very successful in obtaining U.S. Army contracts for his research studies. A 1990 contract with U.S. Army Chemical Research, Development & Engineering Center (CRDEC) has enabled Dr. Rodriguez to purchase major instrumentation such as Fourier Transform Infrared (ft-Ir) spectrometer and a High Performance Liquid Chromatography unit. These instruments are used on a daily basis by all of Dr. Rodriguez's students. The initial success of this contract work has served as a springboard for Dr. Rodriguez's research work. CRDEC has expanded the scope of the original project to include investigation of chemical and biological sensors, energetic molecules, and aerosols and systems.

Cooperative Programs

The Army High-Performance Computing Research Center (AHPCRC) was established in 1989. The AHPCRC serves as a model for linking the University of Minnesota with two HBCUs—Howard University and Jackson State University.

Howard University was the first university to be selected as an affiliate of AHPCRC. This initiative will allow the university to become involved in the nation's most advanced computer science research and, at the same time, to investigate areas of super computing that are of special interest to the Army. The AHPCRC provides both hands-on instruction and motivation to both undergraduate and graduate students from HBCUs.

Dr. Tepper Gill, director of Computational Science and Engineering Research at Howard University, received Army funding in 1990 to install a state-of-the-art fiber optics configuration linking more than 40 advanced work stations on campus to a super computer providing a gateway to more than 5,000 commercial and public networks (Internet). More recently, the Army provided Dr. Gill additional contract support in the design and installation of the first telecommunications network among HBCUs.

Dr. Steven Richardson, associate director of the Materials Science Research Center at Howard University, is being supported by the Army Research Office to study the electronic structure theory of novel semiconductor systems. Dr. Richardson and his students are developing first-principles computational techniques to study the electronic and structural properties of artificially-structured semiconductors in reduced dimensions.

HBCU Center of Excellence

The Army research Center of Excellence (CoE) Program, first launched in 1979, brings together a critical mass of university researchers to advance militarily-relevant technologies. The Army Research Office currently manages eight Centers of Excellence and 31 DOD University Research Initiatives (URIs) in such areas as artificial intelligence, rotary-wing aircraft, mathematical sciences, electronics and optics.

Clark-Atlanta University and Morris Brown College were recently awarded $2.25 million each for three years under the Army's Center of Excellence Program. They are the first two historically black institutions selected to receive funding under the Army's Centers of Excellence program.

Clark-Atlanta will specialize in information science to provide the Army with the support needed to collect, sort, integrate, manage, and evaluate increasing qualities of automated information used in battle management and combat operations. Morris Brown will specialize in research on Army training and how future soldiers can maintain peak proficiency during combat operations.

The Army Research Office, through its Centers of Excellence, conducts institutes during the summer months targeting minorities and women. The principle objective of the Summer Institute Program is to nurture and retain promising undergraduate students, and provide them with a firm foundation for graduate student studies in mathematics and computer science. Obtaining this objective positively affects the pipeline of qualified students in selected areas of mathematics and computer sciences that are basic to all Army critical technologies.

The three sites of Summer Institutes were the Center of Nonlinear Analysis located at the Carnegie Mellon University, the Center for Artificial Intelligence at the University of Pennsylvania, and the Army High Performance Computing Research Center at the University of Minnesota.

Margret James is a Howard University student who was selected to participate in the AHPCRC Summer Institute Program offered by the University of Minnesota. While at the University of Minnesota, she was introduced to the world of super-computing. Her participation in the Summer Institute has influenced her interest in pursuing a career in super computing.

The initiatives defined above spell out Army leadership commitment to the HBCU/MI program. The Army's approach fully meets the intent of Congress and will have the potential to deter manpower deficiencies predicted by demographers for the year 2000 and beyond.



Clark-Atlanta University and Morris Brown College recently received awards under the Army's Center of Excellence Program. Shown left to right are: Daniel R. Gill, director, Small and Disadvantaged Business Utilization; Dr. Gloria Anderson, interim president, Morris Brown College; Dr. Kofi Bota, vice president, Clark-Atlanta University; Dr. Daphne Kamely, director, Research and Laboratory Management, OASA (RDA); and Dr. Gerald J. Iafrate, director, Army Research Laboratory.

DR. JOSIE SCALES is a full-time professor of sociology at Morris Brown College in Atlanta, GA. She recently completed an HBCU Summer Fellow Program in the Office of the Deputy Assistant Secretary for Research and Technology, Office of the ASA(RDA), in the Pentagon.

CATHERINE KOMINOS is the chief of the Bridging Concepts Team, Combat Engineering Directorate, U.S. Army Belvoir Research, Development and Engineering Center, Fort Belvoir, VA. She is currently on temporary assignment in the Pentagon in the Office of the Deputy Assistant Secretary of the Army (Research and Technology).

WELDING OF COMPOSITE MATERIALS

By Diane S. Kukich

Background

Originally developed in response to the needs of the aerospace industry, composite materials are receiving increasing attention from other potential users, including the U.S. Army. Composites are materials with two or more components (fibers embedded in a matrix) that combine to yield characteristics superior to those of the individual constituents. Strong and light weight, composites are resistant to corrosion and damage, and they are durable under harsh environments.

Today, the most commonly used composites are polymer-matrix composites (PMCs). PMCs are of two broad types—thermosets and thermoplastics. Thermosets are solidificd during processing by irreversible chemical reactions, when the molecules in the polymer "cross-link." Thermoplastics, on the other hand, soften, melt, and resolidify. This cycle can be repeated numerous times and offers benefits for manufacturing, joining, and repair of components. The main advantages of thermoplastics are an infinite shelf life, a wide range of processability, and high toughness.

With the widespread utilization of composites, making individual components is just the first step in a truly production-viable fabrication process. The next step in producing a structure is assembly and joining of the separate components. A considerable amount of effort is now being focused on bonding techniques that take advantage of the "fusible" nature of thermoplastics. A group of researchers at the University of Delaware's Center for Composite Materials, an Army Research Office (ARO)/University Research Initiative (URI), are developing novel techniques to join thermoplastic composite parts to one another, as well as to parts made of other matcrials like mctals and thermoset composites.

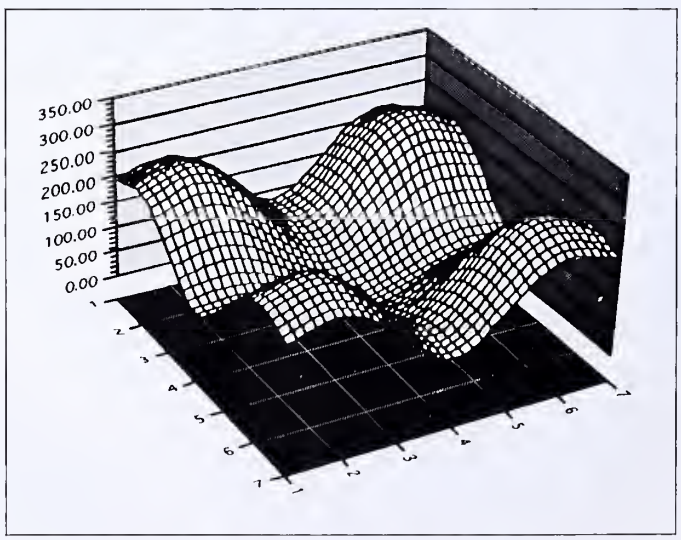
Introduction

Composites have traditionally been joined either with adhesives or with mechanical, or bolted, fasteners. Both of these methods present problems, however. First, the joints introduce a "foreign" material into the composite. Second, they present manufacturing difficulties. Mechanical fasteners require drilling through the composite, causing fiber breakage that can lead to ultimate failure by triggering delaminations and cracks in the composite. Bolted joints also add weight to the structure, negating one of the advantages of composites. And adhesive bonds, although structurally efficient, require elaborate surface preparation, which increases cost and reduces production efficiency.

These problems have led to the investigation of other joining methods, including resistance and induction welding, for thermoplastic composites. Welding of composites is essentially like welding of such traditional materials as metals in that it involves local melting and solidification to join two parts together. The primary difference between any two welding methods is the heating method used to bring about melting, but both the resistance and induction methods offer such advantages as reduced cycle times, low part count, minimal surface preparation, and—because of the first three factors—reduced cost.

To bring these composites welding techniques to the manufacturing floor, a number of questions are being addressed: What are the optimal processing parameters, or conditions, for producing a high-quality joint that will hold up under a variety of environmental and loading conditions? Can the process be repeated so that the joints produced are of uniform quality from one run to another? Can the findings reached using the Center's laboratory-scale research equipment be accurately applied to a scaled-up industrial production line?

To ensure quality and repeatability, an automated process employing sensors for on-line monitoring and control is being developed at CCM. This system will allow the process to be controlled and real-time nondestructive evaluation (NDE) to be carried out—both of which are essential for low-cost, reliable, and maintainable composite components.



Predicted equilibrium surface temperatures for induction welding. Figures at left are degrees C.

Resistance Welding

In resistance welding, a heating element is placed between the parts to be joined, current is applied, and resistance heating causes the polymer at the interface to melt and bond the

components under pressure. In the center's work, a variety of heating elements have been investigated. In one unique case, conductive carbon fibers themselves are used as "in-situ" heaters. In some applications, the same fibers contribute to the structural properties of the part.

After early fundamental research that resulted in the development of a molecular diffusion model to predict the strength and toughness of joints based on the thermal (or heating) history, the CCM research group developed an automated sequential resistance welder to impose these optimal conditions on an actual process. The machine uses a "step-wise" welding approach, in which small segments of large components are joined sequentially, substantially reducing the power and pressure that would be required to join the entire surface at once. With this approach, the size of the joint is, for all practical purposes, unlimited.

Center researchers are now using the welder to investigate the relationship between the processing conditions (primarily temperature, pressure, and time) and the performance of the resistance-welded joint. They have found that heat generation within large welds must be homogenous to ensure optimum performance and quality. Thermal gradients, or differences in temperature from one part of the weld to another, are a greater problem than in small joints.

The researchers have also made a number of findings about the role of pressure in welding. During the fusion bonding of thermoplastic composite laminates, the polymer at the bondline interlayer flows, producing intimate contact between the adherends, or surfaces being joined. This flow process is governed by the temperature-dependent viscosity of the interlayer polymer, the consolidation pressure, and the geometry, or shape, of the adherends. The extent of the flow determines the joint bondline thickness, which relates directly to the mechanical performance of the joint. A poor fit between the mating parts can result in bondline thickness variations that affect mechanical performance.

A model to predict bondline thickness was developed by analyzing "squeeze flow," or how much of the molten polymer flows out. If sufficient pressure is applied, void nucleation and growth can be suppressed due to absorbed moisture. The researchers have also found that laminates subjected to high temperature may come apart unless sufficient pressure is applied during processing. All of this information is critical because consolidation pressure can be completely controlled in the automated welder—once the effects are known, the correct pressure can be selected to maximize performance and quality.

The resistance welder has evolved into a test-bed for the evaluation of various non-intrusive sensors. CCM researchers are relating the information provided by the sensors to the processing parameters—i.e., temperature and pressure. The sensors provide feedback on how temperature and pressure affect the material during processing so that the optimum processing conditions can be selected on-line. Multiple sensors are being investigated because a range of information is needed to understand the behavior of the material, and each technique provides a certain type of information. The only way to see the entire picture—and thereby control the process—is to use a variety of sensors simultaneously.

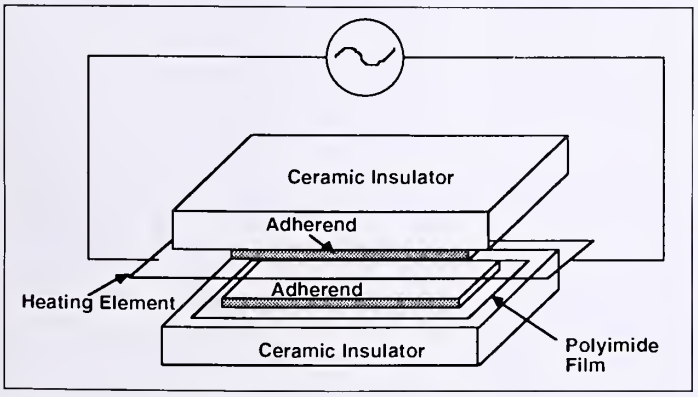
Induction Welding

In induction welding, heating occurs through a magnetic field, with conductive particles embedded at the composite-composite bond interface. An attractive joining technology for thermoplastics, particularly for large parts, induction welding is a non-contact technique that enables components to be welded with access from only one side. The Army is particularly interested in using this method for field repair.

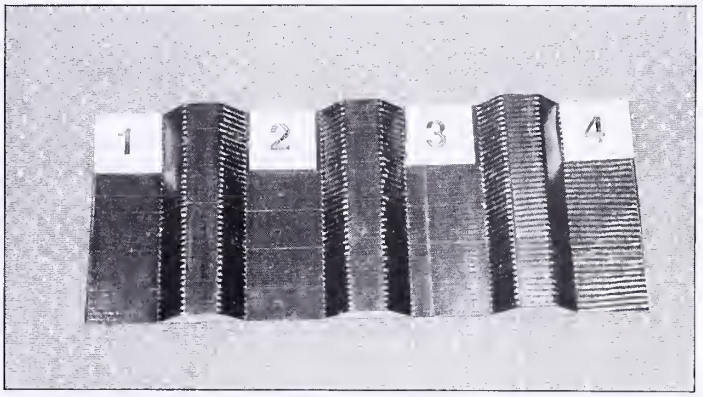
While the center's induction welding research is far less mature than its work in resistance welding, Army Captain Bruce Fink recently made a major contribution to the program. In 1991, CPT Fink completed a doctoral degree in the University of Delaware's Material Science Program, with research that focused on heating of continuous-carbon-fiber-reinforced thermoplastics by magnetic induction. Fink developed several models that will provide the foundation for the next stage of induction welding research.

New Research—Welding of Dissimilar Materials

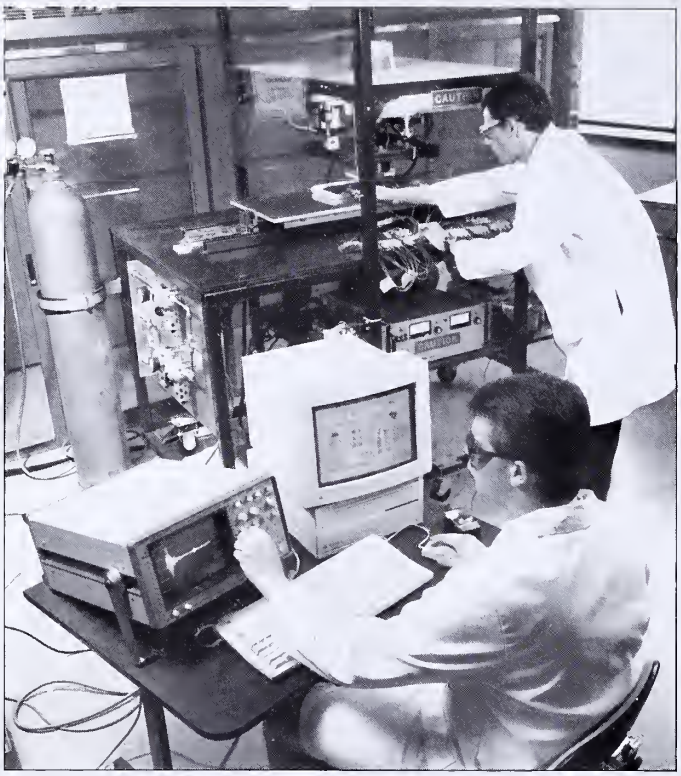
Most recently, CCM researchers have begun to investigate the welding of dissimilar materials. There is a critical need to develop such techniques, primarily because history has shown that materials are generally substituted on an individual component basis. For example, one part in a previously all-metal assembly may be fabricated from a composite, while the others continue to be made of metal. The new composite



Typical weld stack for resistance welding.



Resistance-welded corrugated structure for F-22 applications. Numbers indicate welding sequence.



CCM researchers apply acoustic emission techniques to monitor the performance of the automated resistance welder.

part then needs to be joined to the metal pieces. A number of dissimilar material combinations are being explored, including thermoset composites using a thermoplastic interlayer; thermoset composites using a novel hybrid thermoplastic "prepreg" (a preimpregnated tape of fibers already infused with resin); and thermoplastic and thermoset composites to aluminum, titanium, and steel.

Work done in collaboration with Sikorsky Helicopters has demonstrated that thermoset subcomponents can be bonded to each other using a novel thermoplastic prepreg interlayer, a concept developed by Sikorsky. CCM developed and defined a control system and developed the process to fabricate the interlayer material. "Lap" joints formed using this technique have exhibited better hot-wet and fatigue performance than adhesively bonded joints. University and industry researchers are now working closely together to bring this technology to the production floor for Army helicopter applications on the Comanche. Sikorsky's primary motivation is to reduce costs, a goal that is achievable with the minimal surface preparation and reduced cycle times (minutes versus hours) associated with this process.

In collaboration with Alcoa, thermoplastic-to-aluminum bonding has been investigated for automotive and ground-vehicle applications. Traditional procedures use thermosetting adhesives, such as epoxies, applied to surface-modified thermoplastic adherends. CCM researchers are now developing methods to join the dissimilar parts by using the thermoplastic matrix in the composite material as an "in-situ" hot-melt adhesive—in other words, one that is an integral part of the process rather than a foreign substance introduced only for joining purposes. Because metals are non-porous, surface pretreatment is still required, but vastly reduced cycle times can be achieved with this technique.

In related work, researchers are investigating the feasibility of manufacturing fiber-reinforced composite parts incorporating metal inserts and attachments using resin transfer molding (RTM), a manufacturing technique in which a two- or three-dimensional textile "preform" shaped like the desired part is infused with a resin. The proposed method should allow composite joints with greater structural integrity, higher load-carrying ability, and greater reliability than traditional methods to be produced. In this fabrication process, the metal inserts or attachments are encapsulated in the preform, and the entire assembly is processed using RTM. The approach should result in increased efficiency because the joining operation is incorporated into the preforming and molding step, eliminating the need for costly and time-consuming post-processing joining operations. The results of this work are expected to be relevant to the Army's Composite Armored Vehicle (CAV) program.

Technology Transfer

CCM has a well-established history of interaction with both the Army and industry and has demonstrated superior ability to transfer findings made in its research laboratories to potential end users. In fact, according to Dr. Andrew Crowson, director of the ARO Materials Sciences Division, among the main reasons for selecting CCM as the ARO/URI Center of Excellence for Composites Manufacturing Science, Reliability and Maintainability Technology in 1986 and again in 1992 were technology transfer and CCM's connection to industry. In addition to direct transfer of research findings to sponsors, CCM offers general technology transfer through a variety of publications and continuing education programs, including an annual composites workshop.

Personnel at Army labs are invited to visit CCM's Composites Manufacturing Science Laboratory, particularly during the workshop (May 18-20, 1993), for lab tours, equipment demonstrations, and so on. CCM researchers hope that these mechanisms play an integral role in filling Army manufacturing technology needs and bringing about the widespread use of composites.

For more information about CCM's research program on composites welding, contact Professor John W. Gillespie Jr., 201 Composites Manufacturing Science Laboratory, University of Delaware, Newark, DE 19716-3144, commercial (302)831-8702, datafax (302)831-8525.

DIANE S. KUKICH is an editor at the Center for Composite Materials at the University of Delaware. She holds B.A. and M.A. degrees in English from the University of Delaware and has five years of experience in writing about composites.

THE ARMY MATERIEL COMMAND'S NEW APPROACH TO PLANNING

By Cynthia L. Tootle

The Army Materiel Command (AMC) is determined to lead the Army in total Army quality. One key aspect of the cultural change needed for total Army quality is customer-focused planning. AMC's understanding of and relationship to its customers must be the focus of AMC strategic and operational planning.

The need for change in the method of planning is further fueled by dramatically reduced resource projections for the military services that demand AMC plan for the future in such a way as to preserve the skills and process vital to AMC's customers. More precise knowledge of customer needs and resources and closer ties to potential suppliers are essential given anticipated fluctuating workload and funding levels and changes from direct to reimburseable funding. AMC's new method of planning will enhance the ability to satisfy customer needs and minimize personnel turbulence. This method is analogous with private sector near-term and strategic planning which is concerned with the customer, marketing strategies, revenue sources, suppliers, capital investments, operational costs, and risks. We call this "business planning" to emphasize the customer focus and are developing and implementing this approach within AMC.

The objective of AMC's business planning is not to communicate to investors as is done in industry, but to forge a team of managers with a common vision of the organization's future, based on realistic customer needs. The management team must also have long and short-term plans for achieving that future. Another objective is for employees to understand where the organization is going and provide them the opportunity to contribute. This will be increasingly important as middle management is streamlined and the employees's direct interaction with the customer increases.

AMC used the Process Action Team approach in developing the new business planning process. A team of planners from the various AMC research, development, test and evaluation (RDTE) activities and the private sector was formed in November 1990. This team reviewed government and industry practices and then developed a detailed business planning process for AMC use. The process was documented in a PERT-type chart along with detailed verbal descriptions of each of the steps to support dissemination throughout AMC. In the fall of 1991, following the development of top-down guidance and strategy, the AMC research, development and engineering centers, test activities and laboratories began implementing the process. Work began at the same time to define the other planning elements of AMC and to begin training on the process.

The business planning process will be implemented at all AMC "business centers." This is the term AMC is using analogous to the private sector's "profit centers." Examples of AMC business centers are test activities; depots; research, development, and engineering centers; acquisition centers; separate reporting activities such as Army Research Office; etc. This provides management with visibility of AMC business strategy two-levels down and provides for AMC-wide integration of common elements.

Other terms that AMC is finding useful in this cultural change include "revenue" and "total workforce." Formerly, typical planning data for many AMC business centers, which were largely direct funded, focused on what types of funds were needed. Now, as the Defense Business Operations Fund and other OSD initiatives help us focus on the customer and the source of funds, the term revenue becomes extremely useful. By focusing on the expected revenue from specific customers, AMC emphasizes the need for dialogue with the customers and awareness of their needs and resources. AMC also found the business centers tended to plan for impacts on the full-time permanent staff but without explicity planning for handling major workload and funding fluctuations. The term total workforce was defined to include all the personnel required to perform the mission, including part-time, temporary employees and support contractors. In examining the plans for total workyears AMC could then look at future workforce flexibility and the plans for the full-time permanent staff.

The new business planning process, summarized in Figure 1, can be described as four distinct phases:

- In the first phase, the managers of a business center clarify the mission and vision of the business center's future in the context of the social, political, legal, technological, and threat environment and guidance from higher headquarters. They may need to look at more than one alternate future, if the situation is unstable.
- The second phase of the process requires intense study of the customers, their needs, and the unique capabilities of the business center to respond to those needs. This informantion becomes the "marketing" plan. The second phase also requires gathering and analyzing a wide variety of data about the business center's infrastructure, people, and financial resources, and the

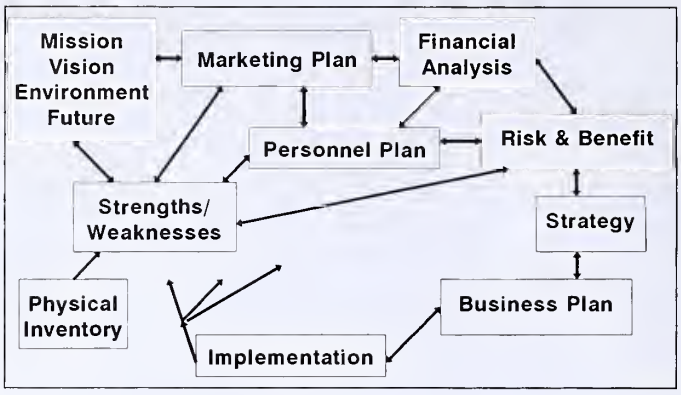


Figure 1. The New Business Planning Process.

business center's strengths and weaknesses relative to customers' future needs. Clearly, the results of the various analyses will impact on one another. For instance, feedback of a negative impression on the part of the customers in a technical area of increasing customer demand may cause managers to rethink strengths/weaknesses or personnel planning. After the data is gathered and the implications analyzed, the business center can proceed to the third phase of the process.

A Summary of the Process

During the third phase, the business center does a detailed risk/benefit analysis of possible strategies, decides which strategy to pursue, and documents this in a business plan. In the final phase, the business plan is implemented and progress is monitored against the strategy. Obviously, the process must begin again as time and environmental changes impact the business center.

The RDTE business centers which helped develop the process have taken the lead in implementation. AMC is seeing the impact of their work. Managers are excited about the new understanding they have of their business center and its future in relationship to their customers. They even speak differently about their organizations. For example, during the quarterly RDE centers' technical directors meetings, discussions on programmatic issues shifted to future customers needs and current customer problems.

Closer working relationships among AMC business centers also occurred during the process of integrating plans. Most of the RTDE business centers have completed the first iteration of the process and AMC is using the lessons learned in implementation at the other business centers.

Clearly, it is highly undesirable for the AMC business centers to plan their business independent of OSD and DA. Effective planning at the business center level requires an articulated vision and strategy for the command within the context of OSD and DA guidance. The AMC Executive Steering Committee for Total Quality Management is providing that vision and strategy.

AMC is preparing a detailed description of its strategy and guidance to the business centers to assure a common understanding of the future environment and directions.

To provide a structure for articulating our strategy for the future, the Executive Steering Committee is focusing on the concept of "core competencies," specifying those unique skills and processes that must be preserved to assure the ability to satisfy the customer. Through the Executive Steering Committee, the business centers are presently expanding descriptions of core competencies by defining their core capabilities. This committee is the forum for the discussion of the barriers to business planning and solutions for removing them.

Planning Within AMC Systems

Effective planning, however, can never be solely a top-down process. The business centers will provide input to the strategy process through the Executive Steering Committee. In addition, the centers will formulate their business plans based on the AMC strategy. Their plans will be reflected back through the system in their submissions to the AMC Program Objective Memoranda, civilian pay plans, and other budgeting and planning actions.

Use of the new data on total workforce, on revenue sources, core capabilities, etc. will allow the examination of trends and implication of the plans at the command level. For example, with AMC's awareness of fluctuations in the future revenues, is the command planning for increasing workforce flexibility to avoid perturbations of the full-time permanent staff?

To energize the change to the new planning process, the AMC Principal Deputy for Acquisition (PDA) is the designated lead for business planning. The PDA will continue to develop and institutionalize the business planning process. The PDA, his peers, and the principal deputies for technology and logistics, will integrate business plans across AMC and develop the AMC level business plan(s).

AMC's industry counterparts tell us that it generally took five iterations before they were "good" at their planning processes. Long before they were satisfied that they understood all the process steps and methods completely, they were seeing payoffs in their understanding and control of their business. AMC already experienced some of this and expects the same increasing return on its time investment.

The benefits of this approach to planning derives from the visibility it lends to the total business center and to the customer/business center relationship. The managers are no longer trying to make decisions on the "eaches" without the larger picture of the customers needs, revenue streams, infrastructure and resources, and total workforce. This approach also capitalizes on the talents of all the managers and employees by articulating the future and strategy of the business center. The employees can share in management's excitement about a successful future and take pride in their contributions.

CYNTHIA LEA TOOTLE served for 16 months as the special assistant for business plans to the Army Material Command deputy commanding general. She has a B.S. degree in applied mathematics from the University of Michigan College of Engineering and an M.S. degree in management science from Fairleigh Dickinson University. She has now returned to business planning at the Army Research Laboratory.

TRI-SERVICE RELIANCE IN AVIATION TEST AND EVALUATION

By COL Joseph L. Bergantz

Introduction

The November-December 1992 issue of the *Army RD&A Bulletin* described a host of on-going initiatives to implement Reliance changes into the science and technology community. The Test and Evaluation Command (TECOM), a major subordinate command of the Army Materiel Command, is meeting the challenges of "Project Reliance" as well. This article will specifically outline the progress of the Aviation Technical Test Center (ATTC), one of TECOM's nine test centers, in applying Reliance concepts to aviation testing and evaluation.

Background

The genesis of Reliance was a Defense Management Report (DMR) decision in October 1989 which directed the services to create a new approach to increase efficiency and reduce unwarranted overlap in research, development, test, and evaluation activities. Since inception, Reliance has gained momentum and has been incorporated throughout the military and DOD agencies. At ATTC, Reliance initiatives are being applied to Army aviation testing at five basic levels: the unit level, ATTC itself; the TECOM level; the Army level; the DOD level; and the intra-federal agency level, such as NASA (see Figure 1). ATTC is involved at each of these levels.

The mission of ATTC is to plan, conduct, analyze, and report on technical tests of aviation systems and related support equipment during development and throughout the life cycle. In this capacity, ATTC is the only Army test center that tests aircraft, component systems, and associated equipment as a total integrated aviation weapon system.

ATTC consists of a command group, a Management and Plans Division, Flight Systems Test Division, and a Technical Test Support and Logistics Division, located at Fort Rucker, AL, which will be called ATTC East for the purposes of this article. ATTC also has an Airworthiness Qualification Test Directorate (AQTD) located at Edwards AFB, CA, which will be called ATTC West.

Flight Systems testing concentrates on system performance and integration, reliability and logistics supportability, human factors engineering, system safety, and modification of aircraft for test. Airworthiness qualification testing at Edwards AFB keys on flight characteristics such as, stability and control, air vehicle performance in level flight, climb/descent, and hover, and flight under icing conditions.

ATTC's Role in T&E Reliance

The primary Reliance challenge facing aviation testers is to move from a climate of cooperation (the main type of interaction prior to Reliance) to a higher level of interaction, such as joint efforts, collocation and consolidation (see Figure 2). In some specific areas, ATTC can also be quite competitive in providing testing and testing support services to other military departments or DOD and federal agencies. Many examples of how ATTC has incorporated Reliance concepts can be cited.

Relative to joint efforts, ATTC has increased the number of joint test projects over the last few years. ATTC West has performed recent artificial icing tests on several sister service aircraft. In particular, the Helicopter Icing Spray System (HISS), a CH-47D with a huge internal water tank and spray boom which generates ice clouds, has been used at Duluth, MN, to test an EC-130 for the Coast Guard, several aircraft for NASA, and is scheduled to test the Marine Corps' V-22 Osprey next icing season. ATTC's HISS is one-of-a-kind and clearly a national asset.

Flight systems testing has also been conducted more frequently in a joint manner. Most recently, the Ultra Lightweight Camouflage Net System (ULCANS) test has been conducted jointly at Eglin AFB, FL, while a radar cross-Section measurement test of several aircraft has been conducted with the Navy at Point Mugu, CA.

Traditionally, ATTC has also supported both the Navy and the Air Force Test Pilot Schools. In fact, two former ATTC personnel are serving as Army members on the faculty of the Naval Test Pilot School at Patuxent River, MD.

Another spinoff of Reliance is the increase in mutual support between TECOM test centers. For example, the Cold Regions Test Center at Fort Greely, AK, has provided extensive support to Army aviation cold weather testing.

During last year's cold weather test cycle, aviators from ATTC were able to test not only primary aircraft, such as the AH-64 Apache, but also conducted ancillary tests on aviator cold weather clothing. Much funding has been saved through such piggyback testing. Similarly, White Sands Missile Range recently provided firing ranges for a joint lashup of Army ATACMS and Apache Airborne Target Handover System aircraft, firing Hellfire missiles at targets, located and passed to Army systems by JSTARS. This is another excellent example of piggyback testing to demonstrate a joint warfare concept and close support between TECOM test centers.

Collocation is the second facet of Reliance in which ATTC has made significant strides. ATTC's Airworthiness Qualification Testing Directorate is collocated with the Air Force's Flight Test Center at Edwards AFB. This collocation has enhanced Army and Air Force mutual support on many projects.

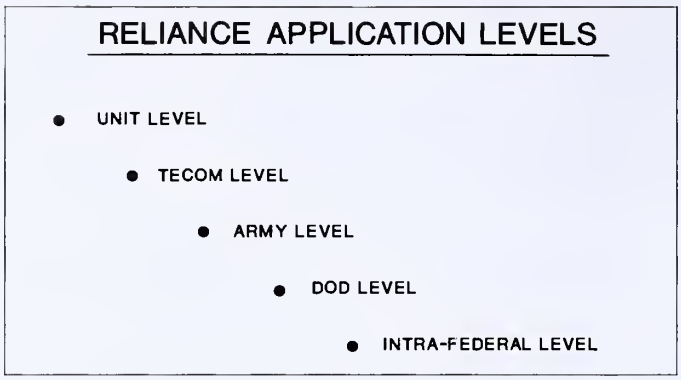


Figure 1.

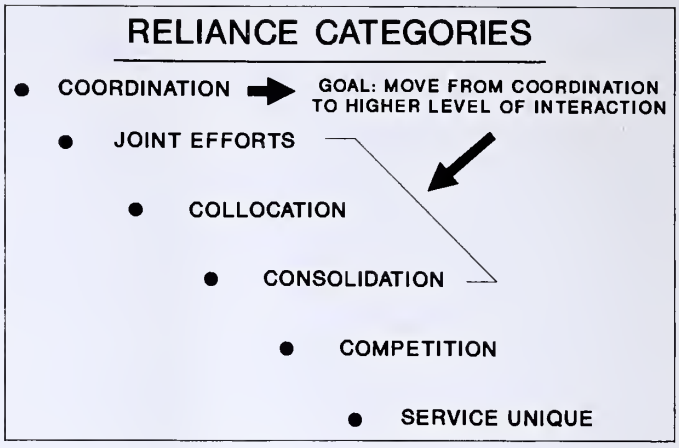


Figure 2.

For example, the Army is currently supporting the C-17 Combined Test Force by providing T-34 chase aircraft support during the paradrop and cargo drop phase developmental testing.

ATTC also flies the NASA photo mission for space shuttle landings at Edwards AFB. In addition, the Army provides the Air Force instructor pilots and rotorcraft for the Air Force Test Pilot School and a reciprocal arrangement exists with Army test pilot students using Air Force instructors and aircraft.

In fact, ATTC West receives all of its base operations support from the Air Force, as well as calibration and laboratory support. ATTC West has also used threat system ranges at the Navy's nearby China Lake facility. Likewise, due to the close proximity of Eglin AFB, FL, ATTC East has habitually used threat ranges there for aircraft survivability equipment tests, the climatic chamber for extreme climatic effects tests, and firing ranges for weapons tests.

Yet another way ATTC East benefits from its location at Fort Rucker is through its close relationship with the Army Aviation Center and School and associated activities there. For instance, ATTC East uses the same logistics support contract for maintenance and repairs. This arrangement keeps support costs low while providing high availability rates primarily due to economies of scale of the much larger Fort Rucker fleet.

Collocation at the home of Army aviation also affords an opportunity for mutual support with other RDT&E tenant activities, such as the Aeromedical Research Laboratory and an element or the Army Research Institute. This collocation has had a synergistic effect and benefits Army aviation as a whole.

A third category of Reliance is consolidation. As a result of the Defense Management Report decision mentioned earlier, the management of Army aviation testing has been consolidated by placing the former Army Engineering Flight Activity under TECOM's former Aviation Developmental Test Activity, thereby establishing the Aviation Technical Test Center. This led to an overall reduction of overhead and the consolidation of most management functions at Fort Rucker, including budget and logistic support, planning for common test and computer architectures and acquisitions, and human factor/system safety engineering support. This is the first of steps to consolidate Army aviation testing.

Downstream potential exists for geographic consolidation. Furthermore, organizational or geographic consolidation of other portions of aviation testing, such as armament/weapons and electronics offer other possible future Reliance opportunities. Ideally, as much as possible, there should be a one-stop testing facility for Army aviation which could further reduce duplication and redundant capabilities.

Finally, competition is a separate category of Reliance in which one military department competes to win the honor of providing a particular service or support to other military departments or agencies.

ATTC has a special niche in the triservice aviation testing realm in the case of rotorcraft, where the preponderance of rotorcraft and rotorcraft testing belong to and are performed by the Army. In this niche, ATTC can provide sister services unique expertise in testing and testing support.

The Army already provides rotorcraft training, maintenance, and logistics support to other services. Extending this existing capability to include rotorcraft testing and testing support is the next logical step.

Conclusion

ATTC has made significant progress in applying Reliance initiatives to Army aviation testing. Certainly, much more progress can be made. Each decision to conduct more joint projects, collocate more units and capabilities at common sites, and consolidate more missions under one executive lead service or organization will require serious thought and consideration. Nevertheless, in these times of dwindling funds and shrinking force structure, Reliance efforts make the most sense. In order to reap the benefits of a fully implemented Reliance program, it may be necessary to spend some additional money up front in order to save a much greater amount of money in the long run.

A skeptic might ask, "How can we afford to make such expenditures"? In keeping with our national military strategy's emphasis on research, development, test, and evaluation for the future, a better question might be "How can we afford not to"?

COL JOSEPH L. BERGANTZ is commander of the U.S. Army Aviation Technical Test Center and is a member of the Army Acquisition Corps. He is a graduate of the U.S. Military Academy, holds a master's degree in engineering management from the University of Missouri at Rolla, and is a licensed professional engineer in Virginia.

PROTECTING THE U.S. TECHNOLOGY LEAD

By CPT Robert A. Newton

Introduction

Although the direct military threat from the Soviet Union no longer exists, the United States is facing a new, subtle threat to its national security. This threat is the effort by traditional adversaries, as well as other nations, to acquire, duplicate or counter key technologies developed in our country. This threat imperils the nation's defense, as well as its economic security.

In an era of multinational corporations, joint development programs, and numerous sales of weapons abroad, the loss of technology to other countries is likely to increase unless positive steps are taken to reduce or eliminate unauthorized transfers.

Background

Spies and espionage have existed for many years. Today, these assets have been supplemented by numerous electronic devices. However, the greatest threat to acquisition programs is still the human agent. In this country, the spy's efforts are aided immensely by our open society. Many topics are openly discussed in public forums in this country which would be highly classified in other countries.

Although the United States had an effective system to counter intelligence operations of traditional adversaries during the Cold War, this system will face a new, diversified threat in the post-Cold War era. In addition to the vast intelligence collection resources of the Russian state, we have additional threats from the other republics. Further, many of our traditional friends and allies have diverted some of their intelligence resources to the collection of scientific and industrial technology programs.

Two major studies clarified the magnitude of this threat to defense acquisition programs. One study was conducted under the direction of Congress, while the other study was conducted by the under secretary of defense (USD) (acquisition). The latter study was known as the Protection of the U.S. Technical Lead.

Of the unclassified findings, the most significant ones concerned the management of security within acquisition programs. The first finding noted that the only document which addressed security issues in most programs was the Security Classification Guide. However, these documents rarely contained any guidance or information on the scope nor intent of the protection effort.

Similarly, another finding noted that DOD lacked central direction for protection planning and oversight. This condition was reflected in program offices and range facilities, where commanders rarely allocated security programs sufficient resources or personnel to implement an effective protection program. In addition, there is a lack of security training in the acquisition

In an era of multinational corporations, joint development programs, and numerous sales of weapons abroad, the loss of technology to other countries is likely to increase unless positive steps are taken to reduce or eliminate unauthorized transfers.

system. Findings of the study underlined the need for a "cultural" change to integrate protection planning into the protection process.

This need was manifested in the study's recommendations. The most significant recommendation was to have USD(A) assign the responsibility for protection planning to the program managers. In addition, the study recommended that DOD allocate counterintelligence and security specialists to the program offices to help the managers develop an effective protection plan.

In addition, the study recommended an integration of protection planning into the curriculum of acquisition training programs. Also, this study recommended the establishment of a DOD-level office to act as the focal point for protection efforts and to develop a master plan to address infrastructure problems.

The Congressional study was the result of FY91 budget hearings. Several of the recommendations of Congress matched those of the PTL study. Congress directed DOD to establish oversight responsibility for protection planning and to identify all costs associated with protection efforts. In addition, Congress directed DOD to develop a strategy to fix the security issues at selected ranges.

These findings led to several changes within DOD. One of the most significant was the establishment of the Acquisition Systems Protection Office (ASPO) as the activity responsible for protection planning oversight within the department.

ASPO was tasked by the under secretary of defense (acquisition) to review the security classification guide and program protection measures of all major acquisition programs, and provide a written assessment to the appropriate Defense Acquisition Board (DAB) Committee prior to each Milestone Review.

When one considers the number of minor acquisition and research programs which feed these major programs, this review authority is more encompassing than it may appear. In addition, ASPO was tasked to address the security infrastructure problem within DOD, as well as develop a method to ensure uniformity of protection efforts for a given piece of equipment across program lines.

The other major change was the incorporation of protection planning requirements in DOD documents which govern the acquisition process. In Part 5, Section F, of *DOD Instruction 5000.2*, program managers are told: "a comprehensive protection and technology control plan shall be established for each defense acquisition program to identify and protect classified and other sensitive information."

Further, this same section states this plan will address:

- the use of counterintelligence and operation security surveys to monitor information loss during system development;
- the definition of threat options (reactive threat) and the potential for exercising those options which could counter the acquired systems capabilities;
- the potential vulnerabilities of the acquired system due to evolving threat capabilities; and
- for international programs, technology assessment and control.

With these initiatives, DOD has attempted to address the concerns expressed in the various studies. The primary method DOD has elected to use to fulfill its oversight responsibility is a review of each system or component's program protection plan (PPP) as part of the DAB process.

THE PPP

Since the development of a protection plan is a requirement for all acquisition programs, a key step is to define its function and role. The ideal plan is one which blends counterintelligence analysis, operations security, traditional security disciplines, and system security engineering to provide an efficient and cost-effective method which will protect the system from all collection threats during development and deployment. To ensure the plan will be fully integrated into the programs operations, DOD Instruction 5000.2 directs program managers to: "develop a protection plan prior to the Milestone I review and update it prior to each subsequent review; [and] produce a protection plan that will include program-related activities at test centers, ranges, laboratories, contractor facilities, and deployment locations for all phases and aspects of the acquisition process."

The ASPO will provide a written assessment to the DAB committees on the effectiveness and efficiency of each program or component program's efforts to meet these requirements. With this degree of emphasis on the PPP in the DAB process, one may wonder what the ASPO will consider during its review. First, the plan should clearly describe the system, as well as the organization of the program office. In addition, the most critical element of the plan is the identification and refinement of the Essential Program Information, Technologies, or Systems (EPITS).

The EPITS of the program are those key elements which give the weapon its unique ability. The identification of the EPITS plays the same role in the PPP as the commander's intent serves in an operations order: they focus the protection efforts and clearly delineate what must be protected. By providing this focus, we should be able to reduce the costs of protection efforts while increasing the level of security provided to the program.

The primary method the program manager uses to identify the EPITS is to "decompose" the system. In effect, the program manager needs to identify those components or technology which give the system its unique ability. Subsequently, each of these candidates are evaluated using four simple questions: If a foreign organization obtained this item, could they devise a method to kill my system? Could they devise a method to clone my system? Could they devise a method to neutralize my system? If a foreign organization obtained this item, would I have to change my design to ensure the same level of superiority on the battlefield?

Carefully related to these questions is the definition of "loss." The program manager needs to determine if the mere possession of the item is a loss or if the other country needs to have the manufacturing capability to produce the item. In addition, the program manager should also consider any manufacturing or fabrication process which may be required to produce the system as a possible EPITS.

Once the EPITS are defined, the program manager should task the intelligence community to determine if any foreign government has an interest in the EPITS and has the capability to collect information on them. If both conditions exist, an EPITS vulnerability exists.

Only if an EPITS vulnerability exists in a given location is the development of a countermeasure required by the ASPP concept. If no vulnerability exists, program managers should not waste resources protecting the item from imaginary threats. However,the program manager needs to realize the threat environment is dynamic. A threat may develop suddenly and needs to be countered if it concerns the EPITS.

The Acquisition Systems Protection Program is a major effort by DOD to protect the technical advantage that American soldiers have traditionally enjoyed in battle.

Once the vulnerabilities are identified, the program manager should place them in a priority sequence. Subsequently, a cost benefit analysis should be performed to determine which EPITS which can be protected with the available resources. Ideally, all EPITS which are vulnerable should be protected. Once this data is compiled, the countermeasures and cost data should be included in the PPP.

Three enclosures supplement the PPP. The Time-Phased Security Classification Guide is oriented upon the EPITS. It contains specific guidance on when an item should be classified, protectively marked, or declassified. The Technology Assessment/Control Plan is used to assess the risk of any joint development or sales to a foreign government. In addition, if such arrangements are allowed, it provides the specific guidance necessary to protect U.S. technology. The System Security Management Plan addresses the engineering and design features necessary to protect the system cost-effectively upon deployment.

Why Should I Care?

Many individuals in the acquisition and counterintelligence communities openly wonder why DOD has directed these changes in the acquisition process. The most common question I have heard from the "field" is, "How is this process different from the previous system?" The other questions center on concerns about the effects upon the cost and schedule of the program.

The answer to the first question centers on the orientation and goals of the program. Although program managers will rely on many of the same rules as before, the difference is the way they are applied. The Acquisition Systems Protection Program (ASPP) concept forces the program office to fully analyze its system, identify its key components, and then apply an integrated package of assets to protect those key elements.

DOD directives provide program managers with the guidance they need to implement this concept, as well as directing the Services to provide the counterintelligence and security assets the managers will need to use. As a result, we are shifting from an emphasis upon "regulatory compliance" into an era where the program manager is responsible for integrating and directing the protection of the weapon system.

This latter point helps clarify the issue of cost and schedule impacts. In the past, the most common theme in the security field was to "protect everything." As a result, many programs wasted funds protecting weapons from threats that did not exist. The other alternative was just as undesirable, when program managers protected very few aspects of their systems. In this case, the result was that 75 percent of our weapons programs had counter systems developed within three years of initiation.

Under the ASPP concept, the emphasis is upon the protection of the most essential elements. As a result, resources are not wasted protecting information which is already known by other governments. On the other hand, the most critical elements receive additional protection. Thus, the ASPP concept should lower the overall cost while increasing the level of protection provided to the system.

Conclusion

The Acquisition Systems Protection Program is a major effort by DOD to protect the technical advantage that American soldiers have traditionally enjoyed in battle. In light of the shrinking budget and extended procurement times, this protection effort is even more important. The ASPP concept is designed to improve individual program and national protection efforts while reducing the costs and administrative burdens through an active management program.

To fully realize how important this mission is to the acquisition community, one should consult the National Military Strategy for 1992. According to the Chairman of the Joint Chiefs of Staff: "The United States must continue to rely heavily on technical superiority to offset quantitative advantages, to minimize risk to U.S. forces, and to enhance the potential for swift, decisive termination of the conflict. We must continue to maintain our qualitative edge. Therefore, advancement in and protection of technology is a national security obligation." Thus, General Powell has clearly stated his views to the community. Now, all we have to do is to comply.

CPT ROBERT A. NEWTON is currently serving as a staff officer in the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence). A 1981 graduate of the U.S. Military Academy—where he has also served as an assistant professor—he is scheduled to attend the Army Command and General Staff College.

U.S. ARMY TEST AND EVALUATION COMMAND: SUPPORTING INTERNATIONAL COOPERATIVE EFFORTS

By Jeffrey L. Pierson

International cooperation in test and evaluation of military equipment is and will continue to be an important aspect of national and military strategy. It supports and complies with guidance from the highest levels, including the joint chiefs of staff, the secretary of Defense and the president.

It does this by establishing a more balanced partnership with allied and friendly nations, supporting coalition warfare and helping to ensure the most economic use of U.S. resources for mutual security. Through the mutual acceptance of test data and use of each others' specialized test infrastructure, the decreasing resources of the United States and its friends and allies can be leveraged to obtain the most quality for their money.

The U.S. Army Test and Evaluation Command (TECOM), with its Foreign Comparative Test (FCT) mission and as the Army Materiel Command (AMC) agent for international test standardization, is emphasizing this function through cooperation with our major arms-producing allies and other NATO nations.

The *National Security Strategy of the United States,* 1990, published by the White House, lists "a stable and secure world" and "healthy, cooperative relations with allies and friendly nations" among the national security objectives for the 1990s. The strategy document expands on these objectives by recognizing that the United States cannot achieve the first objective without the second. These objectives are reiterated in the *National Military Strategy,* 1992. As "forward defense" becomes "forward presence," international cooperation becomes an imperative.

With the success of the policy of containment and the "rightsizing" of the Army, the United States now expects, and needs, our allies and friends to assume a greater share in providing for common security. The implication of these national objectives is that, as the U.S. military is reduced overseas and restructured for a differing role, we need to help, work with and depend more on our allies in cooperative defense programs. As stated in the *Joint Military Net Assessment (JMNA),* 1991, published by the joint chiefs of staff: "In a future of declining budgets and forward presence, we increasingly will rely on international security relationships to further our global interests. We also must prepare ourselves to fight as part of an ad hoc coalition if we become involved in a conflict somewhere where no formal security relationships exist." Commonality and understanding built during cooperative efforts with our allies could be critical to enhancing collective security.

International cooperative efforts benefit the United States in both national security and economic terms. Combining our economic and military strengths will lessen the economic and security burden on any one country. Again, the JMNA states: "Defense cooperation is a generic term for the range of activity undertaken by the Department of Defense with its allies and other friendly countries to promote international security. Such activity includes, but need not be confined to, security assistance, industrial cooperation, armaments cooperation, foreign military sales, training, logistics cooperation, cooperative R&D, foreign comparative testing, and host nation support.

"International cooperative programs with allied and other friendly nations constitute an increasingly important element of U.S. national security and defense acquisition strategy in the post-Cold War era. These programs also seek to recognize two new realities: that we could benefit from access to allied military technology and systems that could enhance the buying power of scarce R&D dollars; and that we could address growing concerns about the health of U.S. defense and civilian technology and industrial bases." Former Secretary of Defense Dick Cheney, in his *1992 Annual Report to the President and the Congress*, says: "The importance of cooperative weapon development programs will grow. Tighter alliance defense budgets will reduce resources available for weapon development and procurement. At the same time, the technology capabilities of our allies should continue to grow. Accordingly, such cooperation will remain an integral aspect of our overall defense acquisition strategy."

Although it is not mentioned specifically in these paragraphs, I think it is important to point out that armaments cooperation, foreign military sales, cooperative R&D, and foreign comparative testing cannot be implemented without test and evaluation.

As part of its mission, AMC promotes cooperation with NATO and non-NATO countries. AMC has prepared a series of strategies to support a restructuring of how the industrial base and the Army acquisition methodology are viewed. The International Armaments Strategy, which also covers the technology base, production base and cooperative R&D programs, proposes a need to ensure modernization and logistical sustainment of the Army's future forces by fully exploring international nondevelopmental item (NDI) possibilities before committing to new developments.

The Test and Evaluation (T&E) Strategy

proposes that the Army will lead in the establishment of international test and evaluation procedures. Although these strategy documents are only in draft form, the ideas are indications of the vision, direction and policy of AMC in the international arena in relation to these areas. They also are being reviewed by the Army Staff for possible dissemination as overall Army policy and as part of the Army Modernization Plan.

It is evident that the future requires even greater economies in the acquisition of military equipment and greater commonality with our allies and friends. Equipment already developed or under development by our major arms producing allies may be suitable for use by the United States and must be searched out. Conversely, U.S. equipment may fulfill a need of our allies.

Commonality of test techniques, terminology and, in some cases, technology, will allow data and information on performance and other acquisition parameters acquired at proving grounds to be more carefully, accurately and quickly analyzed with regard to a nation's needs and requirements. The need for expensive, duplicative, confirmatory re-test and evaluation efforts will be reduced. This will work both ways, leading to more foreign materiel acquisitions, sales, coproductions, and cooperative development programs. It will not be easy to overcome the "not invented here" attitude, and not all technologies can be shared due to sensitivity. However, the capabilities of our major arms producing allies should not be underrated and the benefits in economic and security terms will be well worth the effort. TECOM has been given, and is taking, the lead in FCT and test procedure standardization.

In December 1991, the International Materiel Evaluation Division, which has the FCT mission, was transferred from AMC to TECOM. The basic FCT mission is to provide cost-effective foreign-equipment alternatives that meet approved U.S. Army requirements. Objectives of the FCT program are to shorten the time required to put a capability in the hands of the user by the adoption of allied materiel and to reduce or eliminate the need for costly and time-consuming R&D programs, reducing total acquisition costs. This has the beneficial side effect of furthering standardization and interoperability, supporting cooperative efforts and fostering goodwill with our allies.

The Army has purchased more than one of every four items evaluated (28 percent) under the FCT Program since 1980. Two of the most recent acquisitions are the German Fuchs (Fox) chemical reconnaissance vehicle and the Swedish Ranger Anti-armor/Anti-personnel Weapon System (RAAWS). There are 12 ongoing evaluations for the Army at this time.

In 1979, TECOM, as technical tester for the Army, was designated by AMC as the lead for international technical test standardization. The objective of this effort is to produce bilateral and multinational test standardization agreements to facilitate exchange of test data.

TECOM has Data Exchange Annexes (DEAs) with 10 countries. These agreements enable the formalized exchange of documentation on proving ground technology and techniques. These agreements also lead to visits and meetings which determine the need for, or interest in, closer cooperation. For example, in 1983 AMC and the Federal Republic of Germany's Federal Office of Military Technology and Procurement (BWB) found it in their mutual interest to negotiate a bilateral Memorandum of Agreement (MOA) "Concerning the Development of Mutually Acceptable Technical Test Procedures."

TECOM used a portion of its extensive library of over 600 Test Operations Procedures (TOPs) as a starting point for negotiating International Test Operations Procedures (ITOPs) on automotive testing of tracked vehicles. France and the United Kingdom expressed interest in this program, and the completed and draft ITOPs negotiated under the bilateral GE/US MOA became the basis for four-nation negotiations under the Department of Defense MOU among the Federal Republic of Germany, the United Kingdom, France and the United States "Relating to the Mutual Acceptance of Test and Evaluation for the Reciprocal Procurement of Defense Equipment," signed in December 1983.

The automotive test procedure work drew the interest of other NATO nations. The program was transferred to the NATO forum under A/C 225 and was expanded to include wheeled vehicles. A NATO working group has completed work on 70 automotive test procedures, called Allied Vehicle Testing Publications (AVTPs), for wheeled and tracked vehicles under two STANAGs.

Interest in standardized, mutually acceptable test procedures has expanded under the Four-Nation MOU to include many other areas such as weapons and ammunition, communications and electronics, NBC protection, missiles and rockets, and air drop/delivery. Twelve working groups of experts are working to produce test procedures in these areas. As an example, the fire control working group of experts under the communications and electronics commodity area has completed six test procedures for tracked vehicle fire control and is working on nine more.

The Four-Nation MOU is not the only international test procedure standardization arena in which TECOM is involved. TECOM is very active within NATO in areas other than automotive test procedures. The A/C 301 working group on Environmental Testing, which covers climatic, mechanical and electrical environments, has completed 15 procedures and has 14 more in draft form. TECOM also is represented in two subgroups focusing on test procedures under A/C 310, on the Rationalization of Design Principles, Test and Safety Criteria for Explosive Materials and Explosive Stores.

TECOM is doing its part to promote and advance international cooperative efforts in accordance with national, DOD and Army strategy, policy and guidelines. The FCT mission and the standardization of test procedures are successful programs. TECOM test centers are ready with state-of-the-art facilities to perform testing and to provide expert advice in support of these and other international programs. The results of the TECOM effort demonstrate that international cooperation can be a successful, rewarding undertaking for the Army and other services.

JEFFREY L. PIERSON is an action officer in the Systems Acquisition Division, Directorate for Technology, U.S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD. He has a B.S. degree in mechanical engineering and has worked in standardization/methodology, and RAM/ILS at TECOM where he was part of the Four-Nation and NATO working group on automotive test procedures for wheeled and tracked vehicles.

Watts New in Soldier Power?

POWER TECHNOLOGY DEMONSTRATORS FOR THE FUTURE LAND WARRIOR

By Selma Nawrocki
and Eleanor Raskovich

Introduction

Current defense planning focuses on the likelihood of major regional conflicts. The greater potential for proliferation of nuclear, biological, and chemical (NBC) weapon capabilities increases the need for the U.S. infantry soldier to function effectively in an NBC environment.

The future foot soldier's warfighting capabilities will be enhanced through the addition of new technologies—microclimate cooling, a soldier computer, individual navigation, enhanced hearing, night vision, helmet displays, voice/data communications, and weapon ranging. These technical refinements will be integrated into a safer, more effective "Soldier System."

Power is the key to operating this advanced suite of technologies. The Belvoir RD&E Center is meeting this challenge with its innovative Soldier Individual Power Program.

History

In 1991, an Army Science Board Summer Study on "The Soldier As A System" identified power as the enabling technology to maximize the future soldier's potential capabilities. Individual soldier power was defined as an essential component of the "Soldier System" concept and crucial to the success of individual microclimate cooling.

In response to this study, a tech base executive steering committee (TBESC) consisting of members from the Army Research Laboratories (Harry Diamond Laboratory (HDL) and Electronics Technology and Devices Laboratory (ETDL)); the Army Research Office (ARO); Belvoir RD&E Center; and Natick RD&E Center was created. The TBESC coordinated and directed the Army R&D community in a Front End Analysis (FEA) and the subsequent development and demonstration of available and future power technologies.

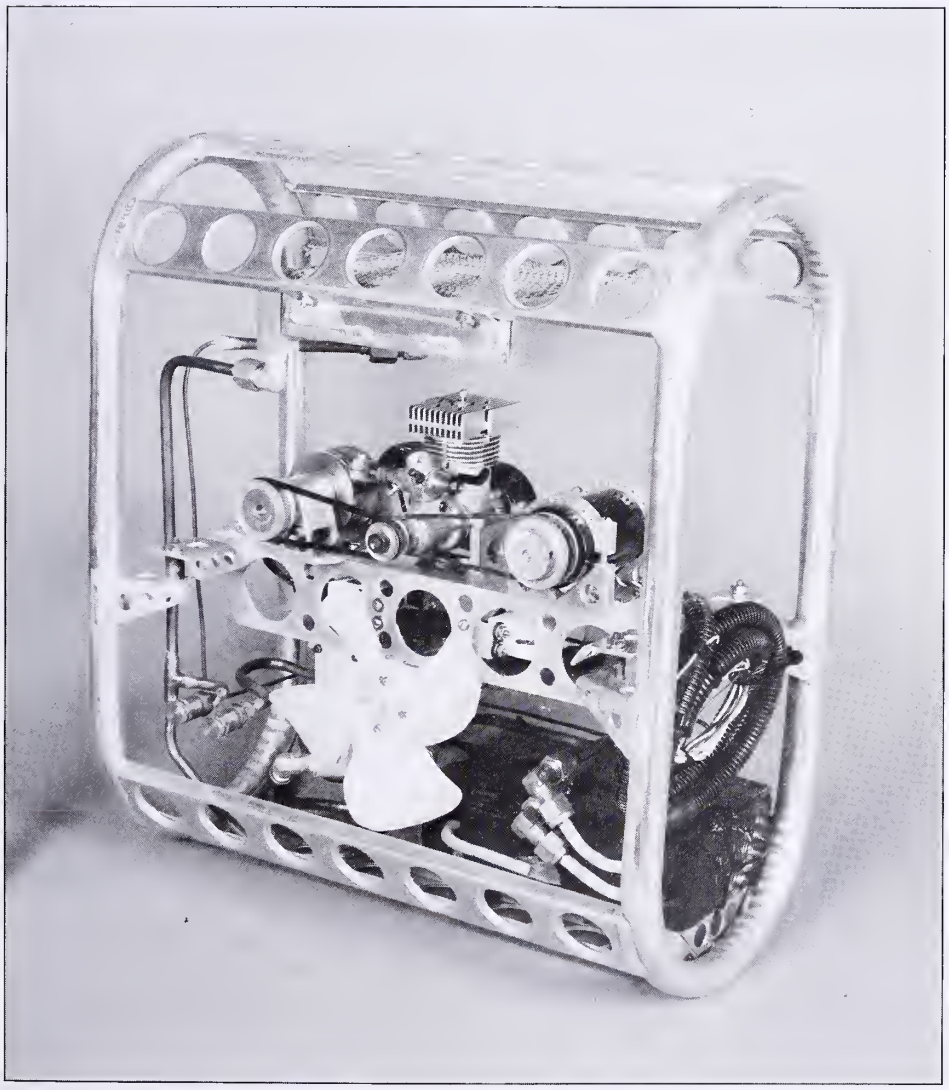
ARO acted as the general advisor for the FEA. The Belvoir RD&E Center, responsible for leading the analysis, provided expertise on various power technologies such as radioisotope, internal combustion engine, and fuel cell technologies. ETDL provided the study with expertise on primary and secondary battery technologies. HDL contributed expertise on vapor cycle systems. Natick, the FEA study sponsor, supplies expertise on Stirling engine technologies.

Individual Power

Belvoir's Individual Power Program was created to satisfy the Army's need for small, lightweight, and reliable power sources for the Soldier System. The performance drivers of the program are weight, fuel, and the need for autonomy (i.e., no resupply).

To enhance and maintain mobility and survivability, system weight must be kept to a minimum. The future battlefield fuel supply requires that the system be capable of operation on military specification fuels such as DF-2 and JP-8. The TRADOC System Manager (TSM) requires the soldier in the field to be autonomous for up to 72 hours including 12 hours in chemical-biological (CB) protective clothing. To date, no available power source using this type of fuel can meet the weight and size restraints and still be capable of reliable operation for an entire mission.

The goal of this program is to develop and test an individual power source which will provide reliable power to cool the dismounted soldier in Mission Oriented Protective Posture IV protective clothing and to power the advanced suite of electrical components of the Soldier System. A lightweight backpack power module will provide mechanical and electrical power necessary for the dismounted soldier in an NBC contaminated environment. The goal is for the backpack to weigh 11 pounds or less (with fuel) and provide 125 watts (peak) of electric power and up to 400 watts (peak) metabolic heat removal for a maximum mission duration of 72 hours with 12 hours cooling.



Belvoir breadboard power unit capable of 100 watts electrical and 400 watts mechanical power.

Front-End Analysis

BRDEC was tasked to conduct an FEA of power technologies for the Soldier System. The basic strategy drew upon the achievements and advances in the areas of power technology from the Army, other services, allies, and industry to provide state-of-the-art technologies and then integrated them to produce a lightweight, efficient power system.

The FEA considered various energy sources, energy storage devices, and energy conversion mechanisms which could potentially meet the needs of the individual soldier. Using detailed criteria, the most promising technologies were selected for near-term demonstrations.

The FEA describes the requirements/constraints for achieving power needed by the dismounted soldier and assesses potential power technologies. The FEA contains a synopsis of the scenarios, proposed systems, analysis process, and rationale for the down-selection of the power technologies.

Scenarios

Since the mission drives the power requirement, it was necessary to define a range of operational scenarios representative of the dismounted infantry soldier using the Soldier System. BRDEC developed three principal operating scenarios with input from the TSM Soldier, the Infantry School, Special Operations Forces, and the Project Manager Soldier. Each scenario defined the environment, equipment, activity level, and weight limitations required for a given mission. The first scenario called for 2,290 watt-hours of energy for 72 hours autonomous operation with no chemical biological protective clothing. The second scenario entailed 2,680 watt-hours for 72 hours autonomous operation, using up to 12 hours of forced ambient air cooling in CB protective clothing. The third and most stringent scenario required 4,790 watt-hours for 72 hours autonomous operation including up to 12 hours of chilled-air cooling in CB protective clothing.

Parametric Study

Once the scenarios were developed, the evaluation criteria to review power technologies were chosen. The most important of the factors were weight, size and cost—in that order.

Using a parametric analysis developed at Belvoir, candidate technologies were evaluated for a full range of mission lengths, cooling modes, operating hours, quantity procured, soldier equipment loads, cooling requirements and technological maturity. The parametric model predicted the weight, size, and cost for each technology for each scenario. The results led to the following selected technology solutions: primary battery-driven power systems, internal combustion engine-driven systems, and fuel cell-driven systems.

Selected Technologies

These selected technologies were evaluated using the mission scenarios defined earlier. This study showed that battery-powered systems are presently feasible only for low-energy (no cooling), short duration (less than 8 hours) missions. For missions requiring more energy, such as cooling in hot climates, a fueled system would be required. The two most promising fueled options were fuel cell-driven and engine-driven systems.

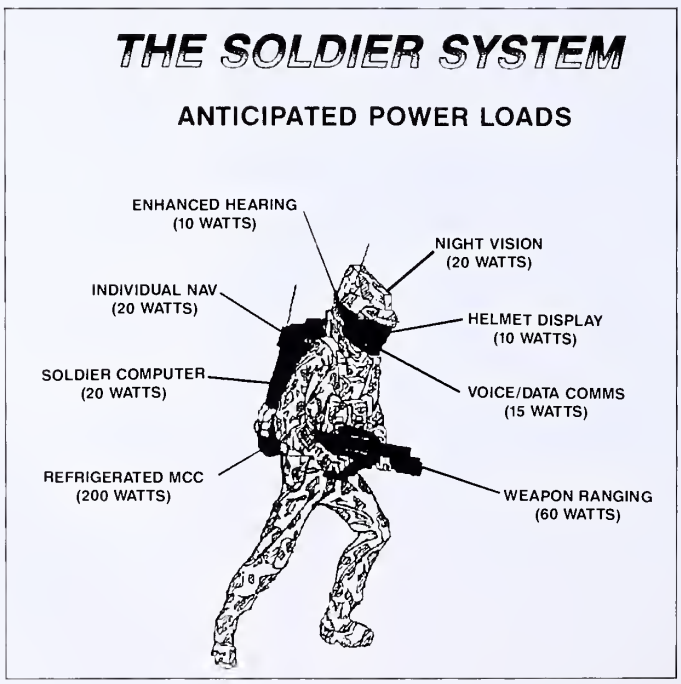
The fuel cell-driven approach has the potential of very low signatures (i.e. thermal, noise) and a higher (but possibly acceptable) size and weight at the technology levels projected by the FEA. However, development is likely to take five or six years longer than the engine-based system.

Hydrocarbon fuel derived approaches include external and internal combustion engines. External combustion cycle approaches include Stirling engines or Rankine type engines. The primary advantages of these approaches are continuous combustion allowing relatively straightforward start procedures, low noise potential, and possible multi-fuel capability. Unfortunately, these approaches also exhibit poor thermal efficiency when using the small sizes required and are consequently very heavy. Thus, the internal combustion engine is favored.

The internal combustion engine-driven approach is potentially the smaller, lighter, and less expensive of the two-fueled approaches. It is important to the Army because it has the potential to achieve high power density and has inherently low manufacturing costs.

Technical Barriers

The engine-based power systems can be realized only if the technological barriers defined in the FEA are overcome. Those barriers are: signature, combustion/conversion efficiency, limitations in ignition characteristics, and component service life.



Achieving adequate signature suppression (noise, thermal, and vibration) is critical to making engine driven systems compatible with human use. One major area of development focuses on attenuating noise through use of active and passive noise cancellation techniques, minimizing vibration through component design and integration, and reducing the thermal signature by eliminating "hot" spots and reducing fuel exhaust particulate.

Improving combustion/conversion efficiency is critical because the weight of the fuel required for many missions is a significant part of the soldier's added load. To achieve the necessary efficiency, fuel consumption will be minimized using precision fuel injection systems; thermal efficiency will be improved using ceramic combustion chamber/piston materials; and overall fuel atomization will be improved.

Overcoming limitations in ignition characteristics is critical to achieving a cold start and to operating on military specification fuels. Techniques incorporating fuel/air heating devices and innovative ignition systems—such as high-energy multi-spark plugs and plasma ignition systems—that are compatible with miniature engine sizes will be demonstrated.

Component service life is a cost driver for fielded systems. Once the required level of performance is achieved, component service life must be addressed to assure affordability. The target is to field a power system with an operating life of at least 350 hours. Other efforts to improve durability may involve the application of synthetic lubricants, high performance seals, ceramic bearings, and high performance heat-exchange surfaces.

Status

Based on the results of the FEA, Belvoir anticipates the availability of sufficiently advanced engine technology to support two technology demonstrators. The first will be tested in FY95 and integrated into the Generation II Soldier System Advanced Technology Demonstrator. This unit will operate in a silent mode for approximately 30 minutes with a rechargeable battery. The second technology demonstrator will be tested and integrated into The Enhanced Integrated Soldier System Preplanned Product Improvement in 1999. Inherent desirable characteristics such as low noise, vibration, and



Soldier wearing MOPP IV gear.

thermal radiation will be demonstrated at that time.

In-house development and fabrication work is ongoing. BRDEC has developed an engine-driven compressor with a permanent magnet generator breadboard unit that weighs approximately 8.5 pounds (without fuel). The FY93 breadboard unit includes: compressor, generator, evaporator, condenser, engine, clutch unit, frame, tubing, belts, pulleys, fan, batteries, pump, DC-DC converter/rectifier (power conditioning), mounting hardware, and servo mechanisms. A second and third unit are under development. These advanced units will be smaller than the breadboard unit with improved signature suppression. All units will be constructed using off-the-shelf components.

Belvoir is currently investigating the operational and performance characteristics of available, lightweight model engines that will fit into a backpack mounted module. BRDEC completed in-house testing of several engine types, including the Migrating Combustion Chamber engine, in 1992. Belvoir also has contracts with several leading industry engine development companies (e.g., Ricardo, Tecogen) for small engine development and fabrication. Southwest Research Institute completed testing of several small commercial gasoline type engines (e.g., chainsaw, weed whacker) in the fall of 1992.

Conclusion

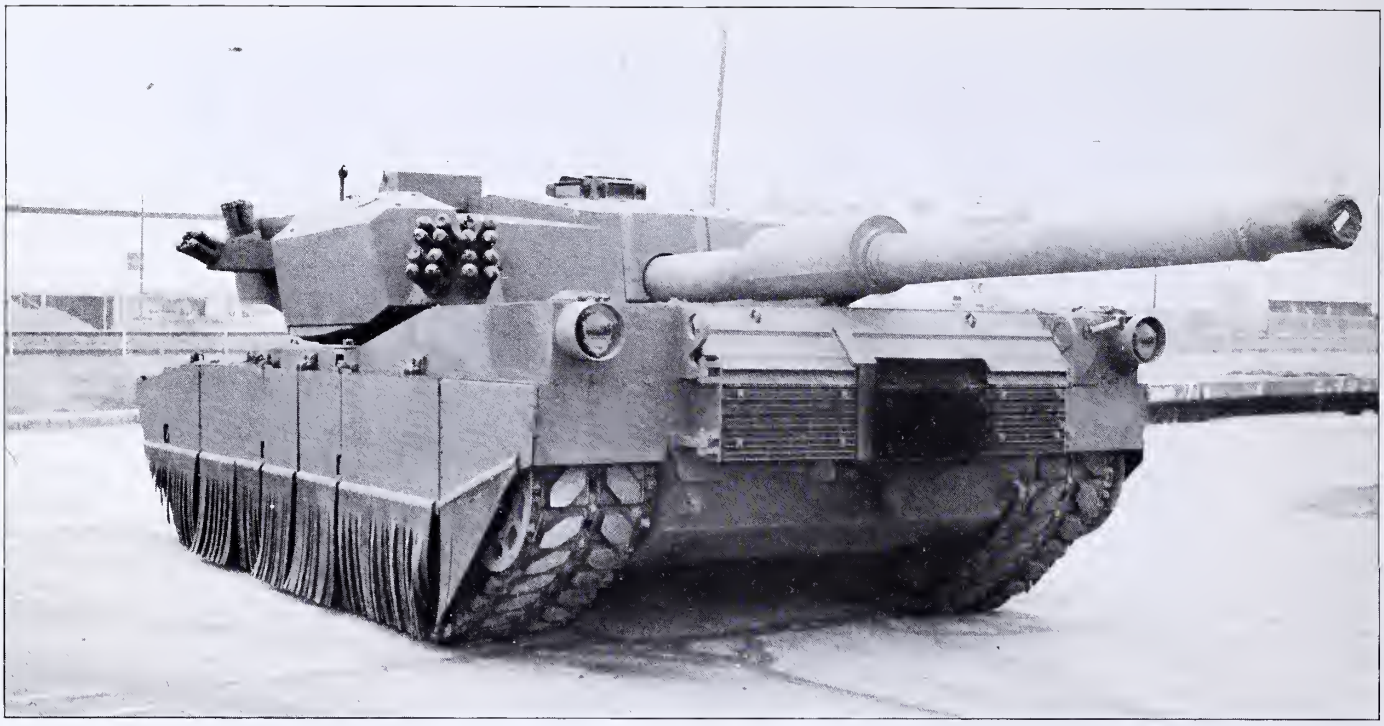
The technological barriers identified by the Army R&D community are consistent with those determined in the recent "Prospector" series of workshops sponsored by the Army Research Office at Auburn University. These workshops confirmed that small internal combustion engine technology is the least expensive and currently the lightest weight solution for the Soldier System, but the signatures and impact of these signatures on the soldier may be too high for some missions. The fuel cells offer promise in the far term due to their projected low signatures.

Whatever the ultimate solution, the future individual "Soldier System" will be powered by the smallest, lightest and most reliable means feasible. Belvoir's continuing developmental efforts promise to make this a reality by the turn of the century.

Despite expected declining resources for defense, the prospects of unforeseen missions, and the dazzle of high-tech weaponry, the foot soldier remains the basic, undeniable component of the U.S. Army. Individual power will contribute significantly to seeing that soldier through the haze of any future battlefield and on to victory.

SELMA NAWROCKI is the project engineer for the BRDEC Soldier Individual Power program. She received her BSEE and MSEE from the The George Washington University in 1985 and 1991 respectively. She began her career in BRDEC as a co-op student in 1981. She has worked in all areas of mobile electric power generation, including testing, field support, production, and R&D.

ELEANOR RASKOVICH received her B.A. in English literature and M.S. in physics from the University of California, Los Angeles, in 1988 and 1990 respectively. She began working at BRDEC in 1991 and works in the Power Generation Division.



The CATTB.

COMBAT VEHICLE TEST BED TO PLAY KEY R&D ROLE

By George Taylor

The U.S. Army Tank-Automotive Research, Development and Engineering Center's (TARDEC) Technology Integration Division has led a group of AMC engineers in the development of an advanced combat vehicle test bed referred to as the Component Advanced Technology Test Bed (CATTB).

The division directed a matrix team comprised of many government agencies and contractors. This group combined its expertise in many emerging technical areas to create an advanced automotive chassis and turret that has been used for various signature-reduction efforts.

The test bed, which was built by TARDEC's Design and Manufacturing Technology Directorate, will allow engineers to evaluate new technologies for use in future Army combat vehicles.

The CATTB chassis is a modified M1A1 tank hull. It features a new propulsion system, new track and suspension designs, and the Army's new vehicle electronics system (called Vetronics).

"The CATTB is much more than just a test bed," said TARDEC's Gene Baker, chief of the Technology Integration Division. "If you look at the program strictly as an effort to develop a test bed, you get nuts and bolts, engines and transmissions and tracks and suspensions. It is true that the engineering effort to develop these items was significant. But when we started out, nobody knew how to apply some of the new technology we wanted in the CATTB.

"For example," he continued, "we didn't know how we were going to apply the new Standard Army Vetronics Architecture (SAVA). We understood basically what it was going to be. But what we found as we began to put the vehicle together was that it would take some special techniques and a considerable amount of technical information exchange between contractor and government people to integrate everything."

The turret has been redesigned to carry two crew members instead of the three required in the M1A1 turret. There is a commander and gunner but no loader. The turret is designed to accommodate an advanced tank cannon system that includes a new lightweight 120mm gun and an automatic loader.

The CATTB's power is being provided by the diesel version of the Army's

Advanced Integrated Propulsion System (AIPS) now being developed by the Cummins Engine Company. (It is one of two competing propulsion systems now under development for use in the next generation of heavy combat vehicles. The other concept uses a gas turbine engine and is being developed by General Electric.)

The Cummins AIPS engine is a V-12, 1682-cubic-inch turbocharged diesel that develops 1450 horsepower. It differs from present-day diesels in several ways. For one thing, it uses advanced heat-resistant materials that enable it to retain part of the combustion heat, normally rejected to the cooling system, which appears as additional energy in the exhaust gas entering the turbocharger.

Another important difference is that this engine is cooled by oil rather than water. The same oil that provides lubrication is pumped through the engine where necessary to cool it. Then it flows through a radiator, where it rejects the heat just as a water-based coolant does in a conventional system. The oil is a special high-temperature diesel lubricant that can withstand higher temperatures than other types of oil.

According to Charles Raffa, TARDEC diesel team leader, an important advantage of these differences is that the amount of heat rejected to the cooling system is reduced substantially and is easier to transfer to the atmosphere. "As a result," said Raffa, "the cooling system is much more compact. Thus, the 240 horsepower normally needed to run cooling fans in a 1500-horsepower diesel tank engine has been cut in half."

Raffa added that fuel economy is also improved because there is more power available to move the vehicle for the same rate of fuel flow.

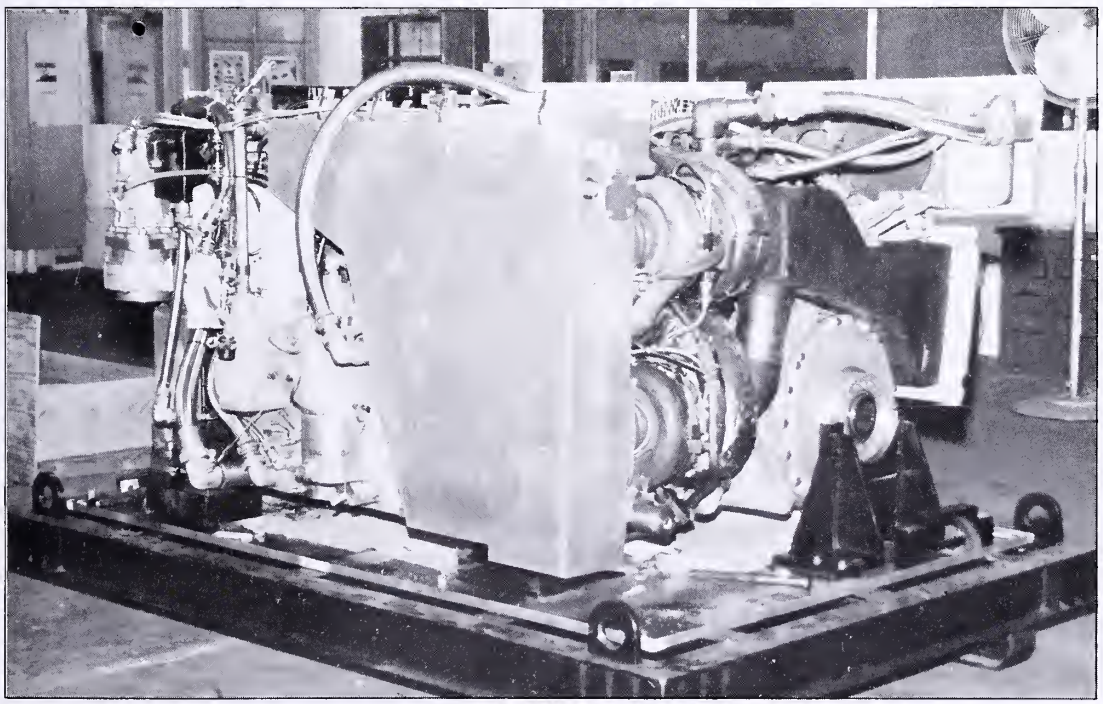
The transmission in the Cummins concept is a seven-speed automatic built by the Allison Transmission Division of Germany's Zahnradfabrik Friedrichshafen AG (formerly a General Motors division). It provides three more gear ratios than the M1-series tank's four-speed gearbox, and it is designed to allow the engine to be mounted transversely rather than longitudinally to make more efficient use of engine-compartment space. Another CATTB feature is a new track design that has 50 percent fewer parts than the standard M1 track and is expected to provide longer life and reduce operating and maintenance costs.

In the current design, two 9-inch-wide track shoes are mounted side by side and span the width of the track pins. Track guides (prongs that extend between dual sets of road wheels to keep the track properly aligned as it rotates around the wheels) are bolted between the shoes. The new track, on the other hand, uses a single 25-inch-wide shoe to span the pins, and the track guide is an integral part of the shoe.

"This track is being designed as a high-durability track. By using a single shoe to span the full width of the track pins, we uniformly distribute pin loading and bushing pressure, which helps to increase track life. We are hoping to get 5,000 to 6,000 miles of track life, compared to about 2,500 miles with the standard M1 track. Also, the track will have full-width replaceable pads, which will nearly double pad life and result in reduced operating costs," said track engineer Michael P. Saxon.

The CATTB has a new suspension concept that represents a dramatic departure from the traditional design. Tanks currently use a torsion-bar suspension. In such a system, one torsion bar for each road wheel is mounted transversely inside the hull. One end of each bar is anchored to the hull, while the other end is attached to a road arm, which extends downward from the hull and is connected to a road wheel and shock absorber.

As the track encounters a bump, each road wheel is kicked upward, and the



The AIPS Engine.



CATTB moving over terrain.

torsion-bar end of each arm pivots. This causes the bar to twist, and the bar's resistance to being twisted creates the opposing spring force that provides the needed cushion between the vehicle and the terrain.

In the new design, all the components are outside the hull. The concept has no torsion bars, but instead features a different type of spring that, along with the shock absorber, is located within each road arm. The system is thus referred to as the external suspension.

The external suspension spring differs from conventional mechanical leaf, coil, and torsion-bar systems in that it is hydropneumatic. It consists of a cylinder filled with nitrogen under high pressure and a piston situated at the top of the cylinder. When the vehicle track encounters bumps, each piston, which is mechanically linked to the vehicle hull, remains stationary while each road wheel forces its respective cylinder to move upward. This causes the nitrogen to compress and act much like a mechanical spring.

The CATTB is set up to test two versions of the system, one by Cadillac Gage, which will be tested first, and the other by Teledyne-Continental Motors. "If it proves to be feasible in the tests," said TARDEC project engineer Michael R. Whitmore, "the concept would have two significant advantages over conventional designs. First, elimination of torsion bars would mean designers could either provide more space inside the hull, or lower vehicle silhouette to make enemy detection more difficult. Also, it would mean a weight saving of about 1,700 pounds in a heavy combat vehicle."

Yet to be installed in the CATTB are the SAVA and the electronic subsystems it will operate. The SAVA was developed by Armored Vehicle Technology Associates (AVTA). AVTA is a joint venture comprising FMC Corporation and General Dynamics Land Systems, in conjunction with General Electric and Texas Instruments.

It was designed as a computer-controlled system with common hardware and software modules that will be suitable for both combat and tactical vehicles planned between now and the turn of the century. It integrates the electronic subsystems and simplifies the complex vehicle wiring harnesses now in use. The control and display functions are standardized and common for all subsystems, thereby making vehicle operation easier. Moreover, the SAVA for the first time provides an on-board, built-in vehicle diagnostics/prognostics capability, which substantially reduces the need to connect external test equipment to a vehicle.

According to Baker, current plans call for TARDEC engineers to evaluate the CATTB's automotive capabilities and conduct vehicle signature-reduction tests here over a two-week period. Following this, the Technology Integration Division will work with Texas Instruments to integrate the vehicle's chassis electronic subsystems with those of other vehicle subsystems in preparation for future developmental efforts involving TARDEC and several other agencies. These include the Tank Main Armament System Program Management Office at Picatinny, Arsenal, the U.S. Army Armament Research, Development and Engineering Center, the Belvoir Research, Development, and Engineering Center, the Communications-Electronics Command, and the Chemical Biological Defense Agency.

GEORGE TAYLOR is a technical writer-editor for the U.S. Army Tank-Automotive Command. He has a bachelor's degree in journalism and a master's degree in communications from Michigan State University.

TEAMING PRODUCES RESULTS

By Donald J. Palughi

The past two years have been extremely challenging and gratifying for two specially formed teams at the U.S. Army Edgewood Research, Development and Engineering (RDE) Center (previously U.S. Army Chemical RDE Center). These teams successfully addressed manufacturing problems that occurred on two smoke munitions programs during production at Pine Bluff Arsenal (PBA). The success of these two efforts is attributed to the composition of the teams and the interaction that occurred between team members to achieve the desired results.

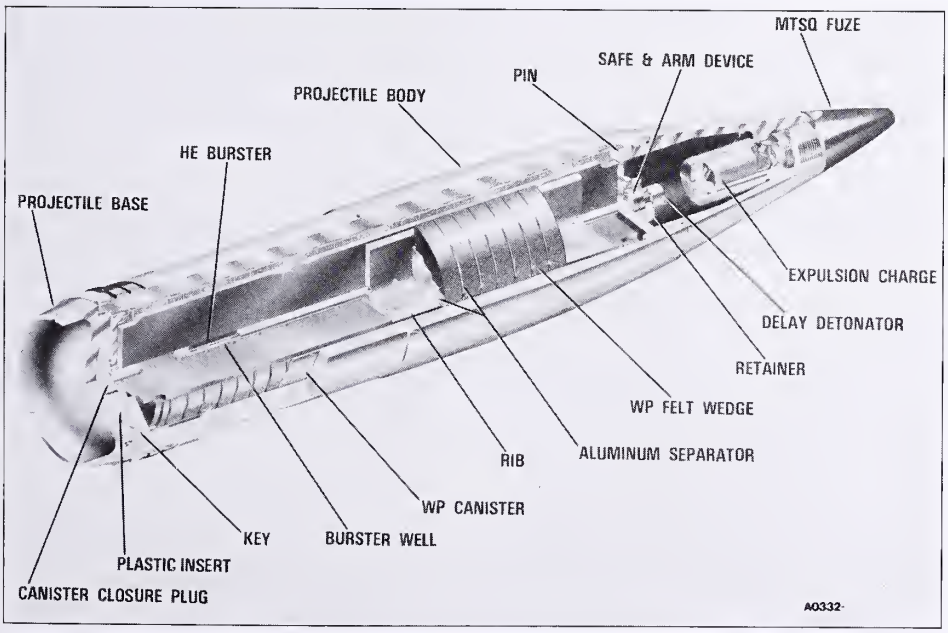
The primary objective of both teams was to review and analyze the engineering and manufacturing details related to production problems on the M825 projectile and M819 cartridge programs and find solutions which would allow production to resume at PBA in the shortest time possible. This article reviews the team efforts that I had the responsibility for leading and highlights the program benefits from the teaming approach.

The teams for both programs were staffed with highly skilled specialists who had the talent and diversified expertise needed to diagnose the problems, determine viable alternatives and recommend approaches to support sustained restart of production. The success of both teams is not only attributed to the technical capabilities of the individual participants, but also to what is well known as "people chemistry," i.e., the compatibility of team members to work well together.

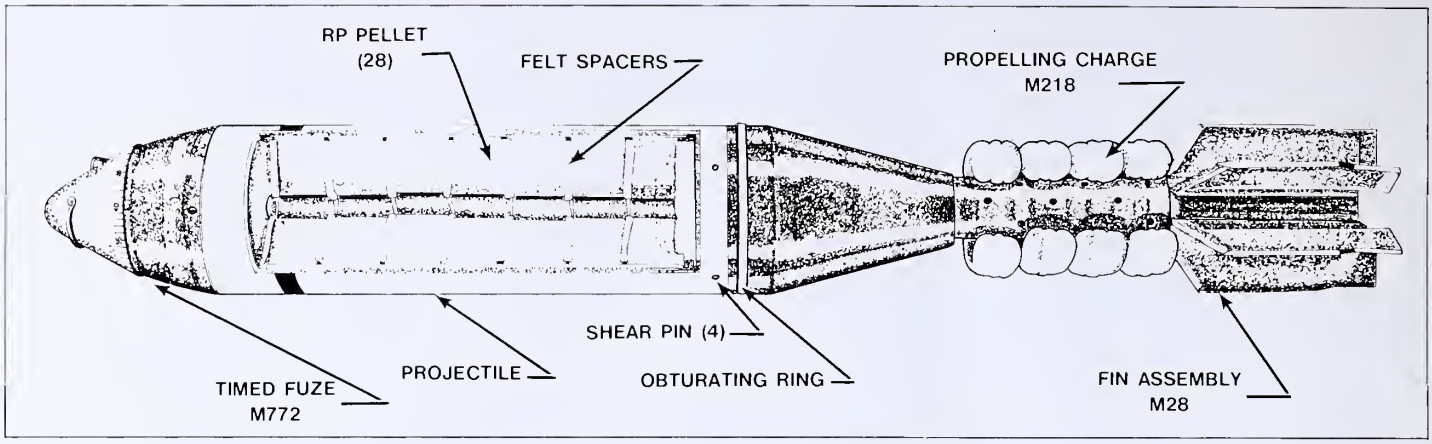
I consider the "people chemistry" to be an essential requirement for the teaming approach to be successful and key to meeting team objectives. Each team remained focused as a unit and had total commitment and resolve to accomplish tasks expeditiously. As a result, working with individuals in such a teaming arrangement is especially enjoyable and rewarding as was the case for all individuals who worked on both of these teams.

A Malfunction Investigation Team was formed at CRDEC in April 1990 at the request of the Armament, Munitions and Chemical Command to address a problem which surfaced during M825 projectile lot acceptance and M825A1 first article tests. During these tests, a significant number of M825 and M825A1 projectile canister assemblies failed to open and disperse their fill to make smoke. The team initiated its efforts by performing a root cause analysis which determined that the probable causes of the problem were in the manufacturing processes of components in the safe and arming module and/or the burster assembly.

The team's broad coverage diagnostic techniques of problem analysis determined that the root cause of the problem was the improper consolidation of the explosive pellets in the burster tube. Corrective measures to solve the problem were tested, accepted, and implemented by an engineering change proposal to the M825 and M825A1 technical data packages (TDP).



Projectile, 155mm Smoke, WP, M825A1.



Cartridge, 81mm Smoke, RP, M819.

The TDP revision successfully supported restart and sustainment of production for both items. Numerous organizations provided a great deal of support.

Organizations that played key roles in getting the M825 and M825A1 projectiles back into production included PBA; Dugway Proving Ground; Armament Research, Development and Engineering Center (ARDEC); Lonestar Army Ammunition Plant; Ballistic Research Laboratory; Naval Surface Warfare Center; and Edgewood RDE Center.

The team's efforts from April 1990 through September 1990 are documented in a center Technical Report titled, "Malfunction Investigation-Projectile, 155 Screening Smoke, M825 and M825A1" and provides lessons learned that could be used to avoid similar problems in future munitions development programs.

In September 1991, a technical team was established at CRDEC at the request of PM-Mortars to assist in resolving a problem that PBA had in producing acceptable red phosphorus (RP) pellets for the M819 cartridge. A new pellet manufacturing process was being used, featuring an RP material produced by a single source North American manufacturer (Albright and Wilson-Americas).

Trial production runs were conducted with the new RP material and with modified pellet mixture constituents and modified process parameters to produce acceptable RP pellets. The pellets were manufactured with revised acceptance criteria for test and evaluation in both chamber and field environments. Data obtained from these tests were used to assess smoke performance of pellets and assembled cartridges. PBA's manufacturing procedures were revised and limited production runs were made to prove the feasibility of using the new RP pellets. The pellets had a modified composition.

The M819 program manager reviewed the performance of the modified RP pellet composition and options for resuming the production of the M819 cartridge based in part on information generated by the multi-disciplined team.

The technical team's efforts from September 1991 through April 1992 are detailed in CRDEC-SP-050 Special Report titled "CRDEC Technical Team Report on the M819 Red Phosphorus Smoke 81mm Cartridge Production Problem." This report includes documentation of topics that need to be considered during the preparation of material specifications.

Process changes by the RP supplier had a significant impact on PBA's pellet manufacturing process. It provides a good example of problems that can occur when material specifications are not fully defined.

Key organizations that helped get this effort under control and back on track included PM-Mortars; PBA; ARDEC; Army Test and Evaluation Command; Army Materiel Systems Analysis Activity; Navy Weapons Support Center-Crane; Albright and Wilson-Americas; Particle Data Laboratories, Inc.; Shell Chemical Company; and Edgewood RDE Center.

The "team problem solving" techniques and approaches utilized to resolve the M825 projectile and M819 cartridge production problems are very similar to those used by concurrent engineering teams in conducting successful development programs. The primary difference is that one team has a known problem that needs immediate resolution because of the delay in getting needed systems to the field and the cost associated with production down-time, while the other must solve engineering problems and ensure that system performance and production requirements are met as early as possible during development. Creative problem solving processes, used to do good engineering design, reap the greatest benefit when the interdiscipline technical teaming approach is fully utilized early in the design process.

Early establishment and use of the multidisciplined engineering project team, as well as the commitment to team throughout the life cycle management process, is the best approach for conducting RDT&E programs to meet the user's needs.

In today's environment of diminishing resources, it is essential that the full gamut of engineering disciplines be utilized to ensure the acquisition of high quality systems that will survive on the modern battlefield. The Edgewood RDE Center is using the teaming approach to successfully implement our programs.

DONALD J. PALUGHI is chief engineer, Research and Technology Directorate, Edgewood Research Development and Engineering Center. He has a B.S. degree in mechanical engineering from Johns Hopkins University.

DISTRIBUTED INTERACTIVE SIMULATION—A PREVIEW

By George T. Singley III
Deputy Assistant Secretary
of the Army (Research and Technology)
and Chief Scientist

Fact or Fiction?

- Determining weapon effectiveness and Combined Arms contribution *during* design.
- Developing tactics, techniques and procedures *prior to the first prototype.*
- Identifying MANPRINT issues *prior to the first prototype.*
- Prototyping *without bending metal.*
- Identifying testing and training issues for new weapon systems long *before the equipment is built.*
- Testing equipment *without the equipment.*
- Soldiers experiencing stress, danger and the 'fog of war' during full Combined Arms maneuver *without leaving garrison.*
- *Refighting* a battle.

The Answer is... Fact, thanks to recent rapid advancement in distributed simulation technology.

During the last two decades, the U.S. military establishment has developed an impressive array of simulators and training systems. These devices are extremely beneficial in training soldiers to do their jobs as individuals or as members of a small team. However, as we found in Grenada, Libya and Panama, the ability to perform a mission as an individual or crew does not guarantee the ability to function as a member of a task force. Mission rehearsal has become increasingly important as combat becomes more complex and uncertain. What we need is a means for commanders and warfighters to experience the 'fog of war' in a simulated environment and learn how to anticipate it in combat engagements.

We have reached the point that there are few locations where we can fully

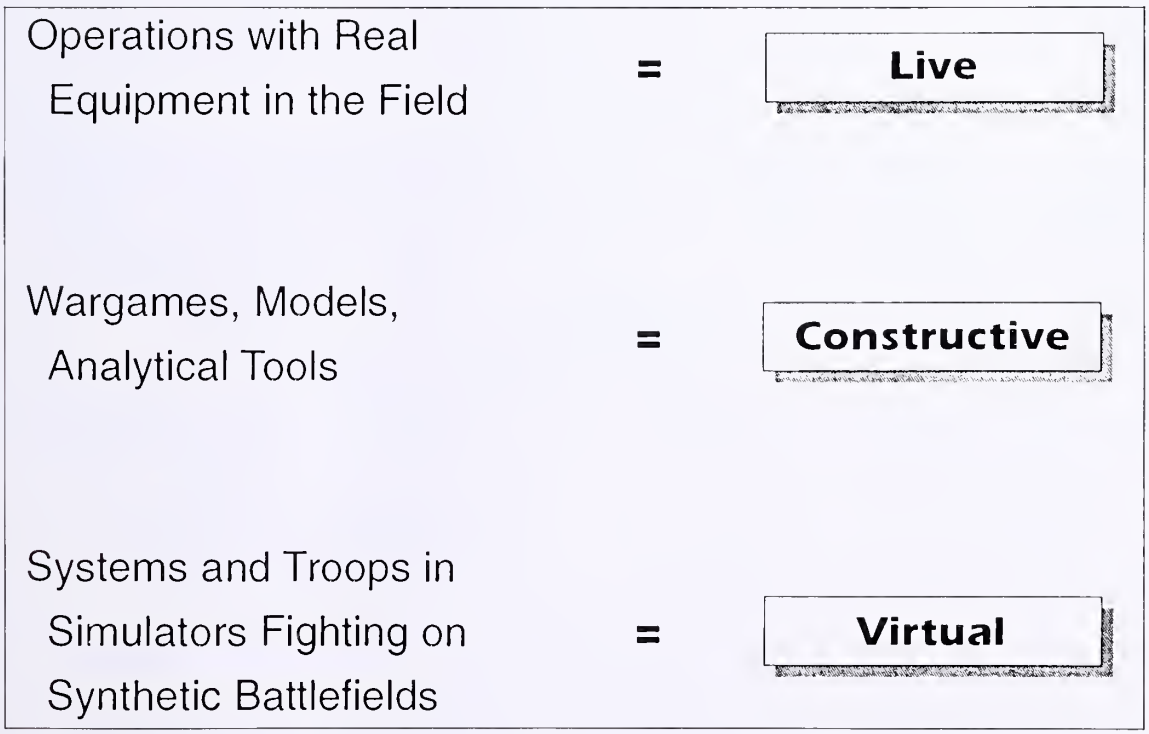


Figure 1.
Types of simulation.

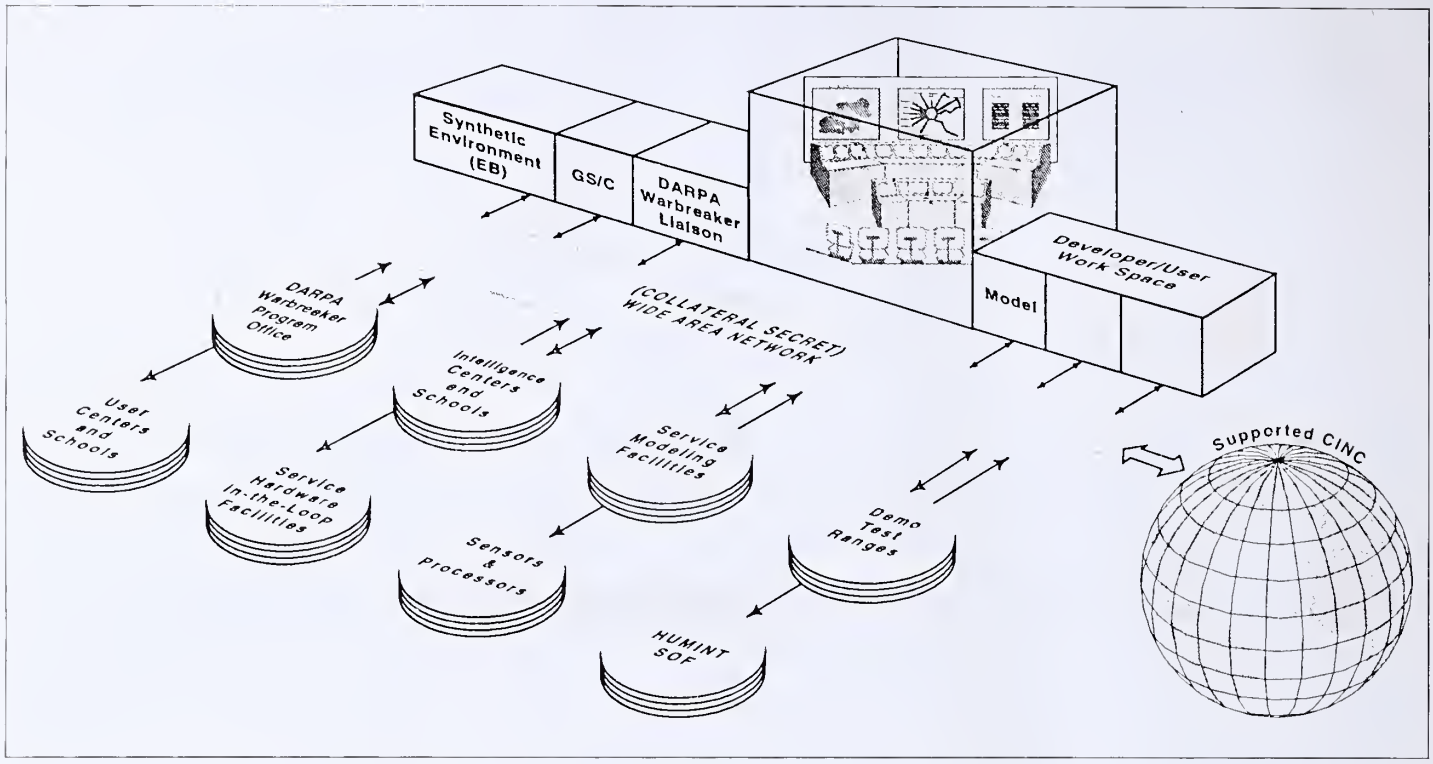


Figure 2.
JPSD testbed concept.

exercise the total combined arms capability, let alone joint operations. Now, it is next to impossible to find an area large enough and an environment safe enough to practice "fighting" modern units and weapon systems. During the last decade, the need for an alternative has become more urgent. Military aircraft participation in combined arms maneuvers in Europe was hindered by local noise abatement laws that restricted low altitude flights. Similar environmental concerns are being raised in the United States that effect both ground and air systems training.

Cuts in the defense budget make it more difficult to sustain, by field exercise alone, the level of force readiness mandated. Networked simulators offer a safe, cost effective environment which can augment live field exercises—one in which we can afford to exercise all the components of today's combined arms teams. This synthetic environment must be affordable, flexible enough to be used without revealing operational capabilities to unauthorized personnel and contain DOD-approved algorithms and databases. This synthetic environment will also provide a modeling and simulation network for use by DOD, industry and academia, and fundamentally alter how we acquire weapon systems and train under real-time wargame scenarios. It will do this by empowering thousands of talented individuals and teams, traditionally separated by geography, invisible functional barriers and time, to work more in unison.

In the Beginning

"Simulation" refers to one (or a combination) of the three types of simulation defined in Figure 1.

Stand-alone models and simulations are not new to DOD. It was only recently (July, 1990), however, that the U.S. Army-sponsored Defense Advanced Research Project Agency's (DARPA) research project known as Simulation Network (SIMNET) was successfully completed. The SIMNET project of the 80s continues to serve as the bedrock architecture and methodology that enables geographically dispersed simulators and simulations to function in Distributed Interactive Simulation (DIS) as we know it today.

DIS creates a synthetic, virtual representation of warfare environments by connecting separate simulations residing at distributed, multiple locations. This property affords the opportunity to configure a wide range of simulated warfare representations patterned after the task force organization of actual units, both friendly and opposing, including the joint and combined operations missions we face both today and in the future.

The simulations making up the network and the computational resources may be geographically separated. Tank simulators located at Fort Knox can be linked with helicopter simulators at Fort Rucker and the computers required to conduct the simulation need not be collocated—in fact, even the logic and databases supporting the simulation may be dispersed. Such is the case with the Army Joint Precision Strike Testbed at the U.S. Army Topographic Engineering Center, Fort Belvoir, VA (see Figure 2).

"Interactive" refers to the interaction between individuals, systems and units, both friendly and threat. DIS

attempts to achieve such interaction in the same manner and to the same degree which real combined arms teams and threats interact.

DIS connections are established via a physical communications network such as the Defense Simulation Internet (DSI) developed by DARPA. Each location physically connected to the network is referred to as a "DIS node." At present, the Army operates two Army Training and Doctrine Command (TRADOC) battle laboratory nodes on the Simulation Internet: Fort Knox and Fort Rucker. We are currently conducting over 40 projects for combat, materiel and training developers on these. A recent Army-wide request for DIS work requirements netted over 150 proposals. Among these proposals are requests to create new nodes, including several laboratory nodes. Eventually there will be approximately six to eight Army-owned Battle Laboratory nodes. The number of communications-only nodes is unknown, but might likely reach into most major commands throughout the Army (Figure 3).

The Players and Uses

Many communities are potential users of DIS technology and methods, including:

• **Combat developers** will use DIS to help them assess new doctrine and tactics, develop requirements, and evaluate force structure. The Training and Doctrine Command has established and is equipping the six battle labs shown in Figure 3. They are focused on the changing dynamics of the future battlefield including tactics, doctrine and supporting technologies. All of these battle labs and schools will make extensive use of DIS in developing requirements, conducting training and wargaming, and directly supporting Louisiana Maneuvers '94 (LAM '94). LAM '94 is a process and tool of the Army focused on warfighting modernization and policy decision making. It will provide Army leaders the capability to address key issues such as the development of new weapon systems, force structure development and doctrine of the future.

In FY94, LAM will begin to collect information from CINC exercises which depend heavily on the use of aggregate level interactive simulations distributed on a global basis. Recent DIS "replays" of actual Desert Storm battles such as '73 Easting and Jayhawk Thunder have allowed enhanced operational analyses and excursions ("what if" studies) of these engagements. In this way, military analysts can exploit DIS to study actual combat by recreating

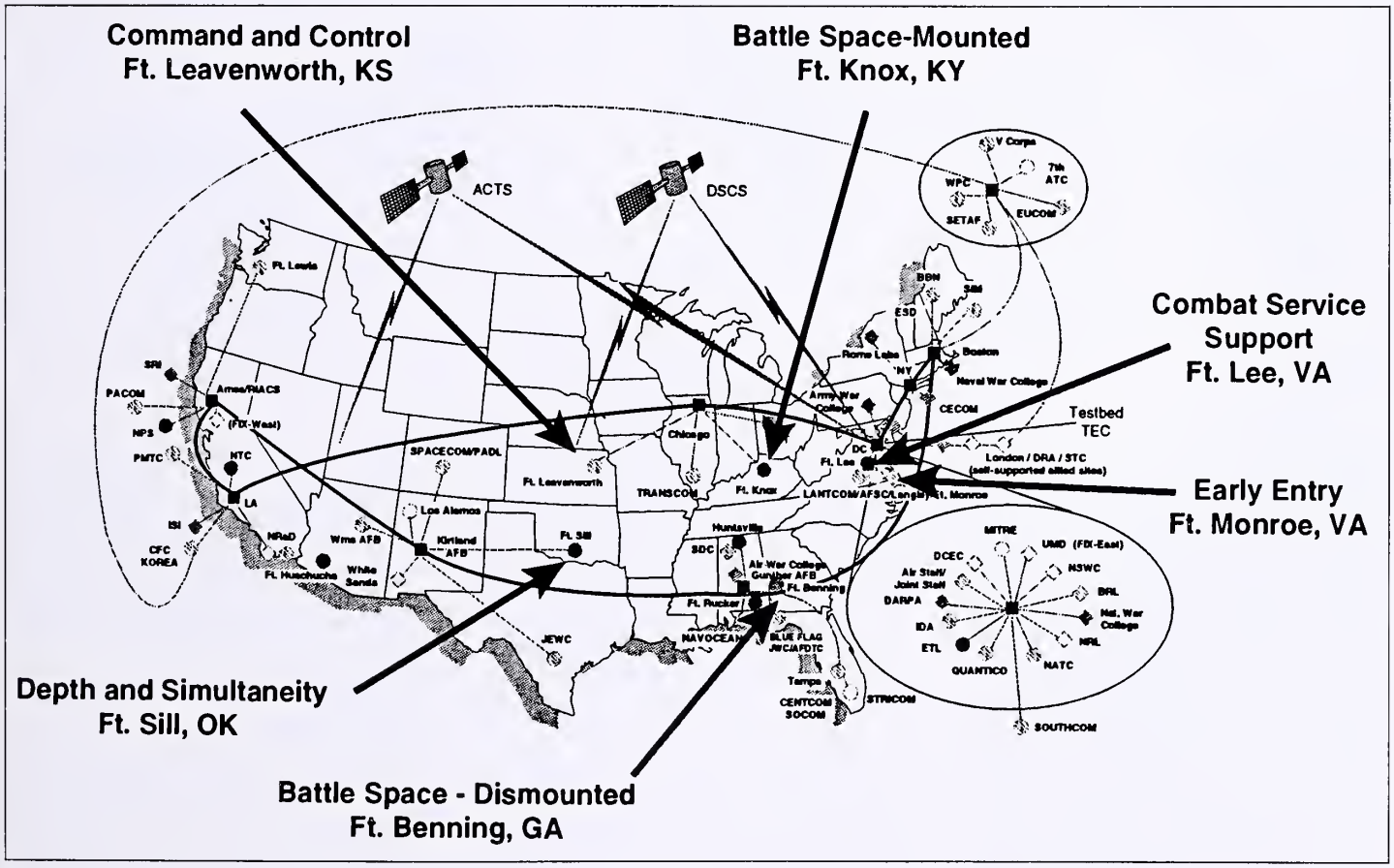


Figure 3.
TRADOC battle labs.

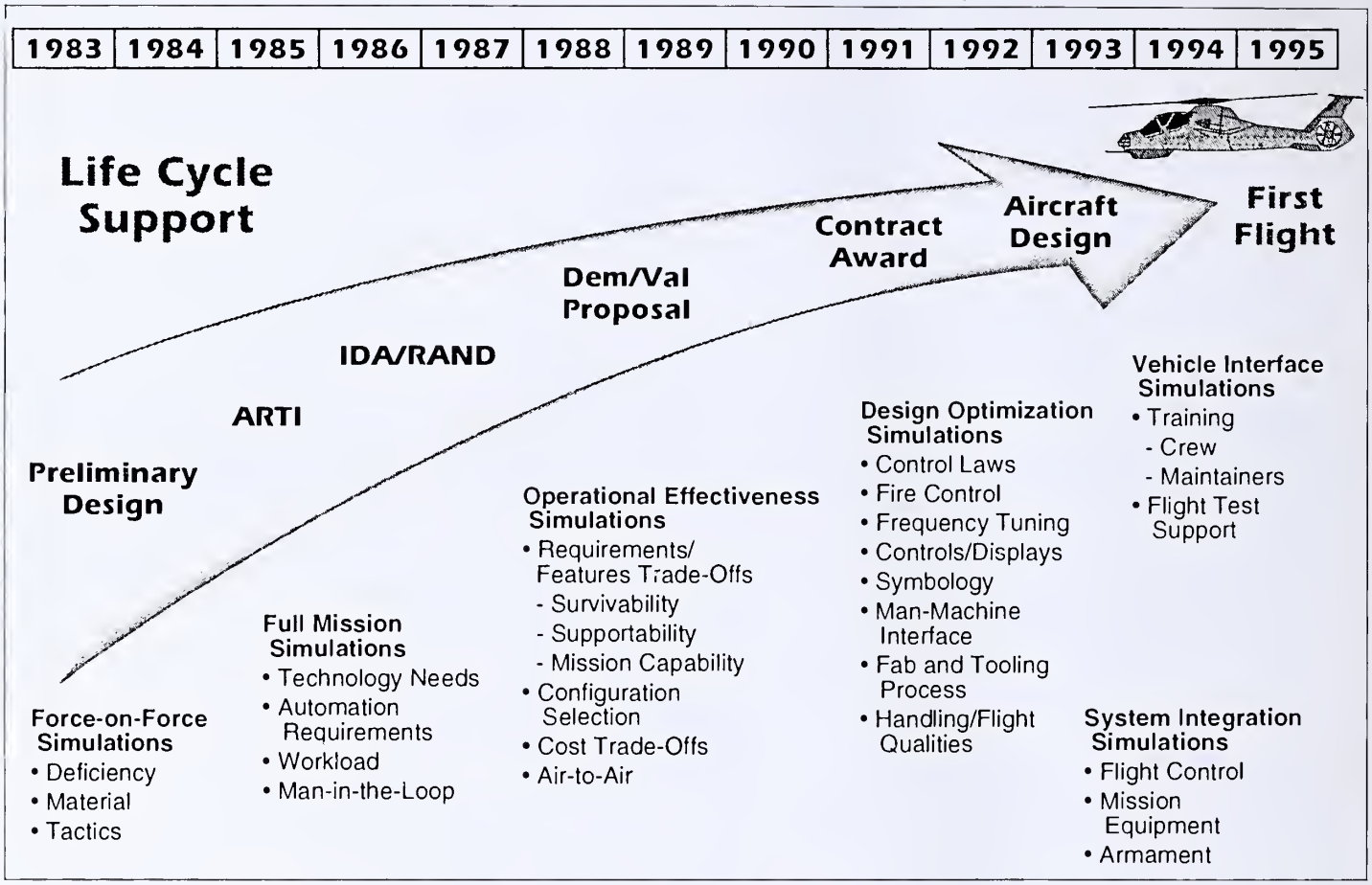


Figure 4.
Simulation interface with the comanche design process.

specific battles and learn valuable lessons.

• **Materiel Developers** will shorten acquisition time while reducing both costs and development risks by employing DIS during concept definition, concept exploration, design, MANPRINT assessments and prototyping. The Army Comanche helicopter program (see Figure 4) has pioneered virtual prototyping. "Virtual Prototyping" offers developers and users the ability to evaluate better and earlier the concept definition, design, development, validation, production and sustainment of a weapon system in a synthetic environment. Virtual prototyping not only facilitates concurrent engineering but also continuous, comprehensive evaluation by the combat development and testing communities. Because almost 90 percent of a weapon system's cost is typically decided before entering development, the DOD acquisition community and industry should no longer wait for errors in the decision making process to be discovered in the production and deployment phase (see Figure 5).

• **Testers** will employ DIS to better plan tests and as a source of supplemental data for their evaluations. It allows them the opportunity to 'test the test' beforehand.

• **Trainers** will be able to determine potential training issues sufficiently early to permit design changes before the first piece of equipment is built. Trainers will conduct otherwise dangerous training with safety, reduce maneuver costs (fuel, maintenance, environmental damage, etc.), and obtain more accurate assessments of completed training. Many Desert Storm warfighters were trained in simulators prior to and during deployment. An essential element of readiness is teamwork, and DIS allows units to train as teams. DIS networks possess extensive replay and after action review capabilities, including clear documentation of the exercise. These reviews will help warfighters learn from their "virtual" mistakes and to experience more and improved training.

The Future

The Army is and continues to be the lead service in developing and applying distributed interactive simulation. Following the completion of the SIMNET project in 1990, the Combined Arms Tactical Trainer (CATT) and Battlefield Distributed Simulation-Developmental (BDS-D) programs were initiated. Both efforts will provide real-time, man-in-the-loop, combined arms synthetic battlefield environment capability.

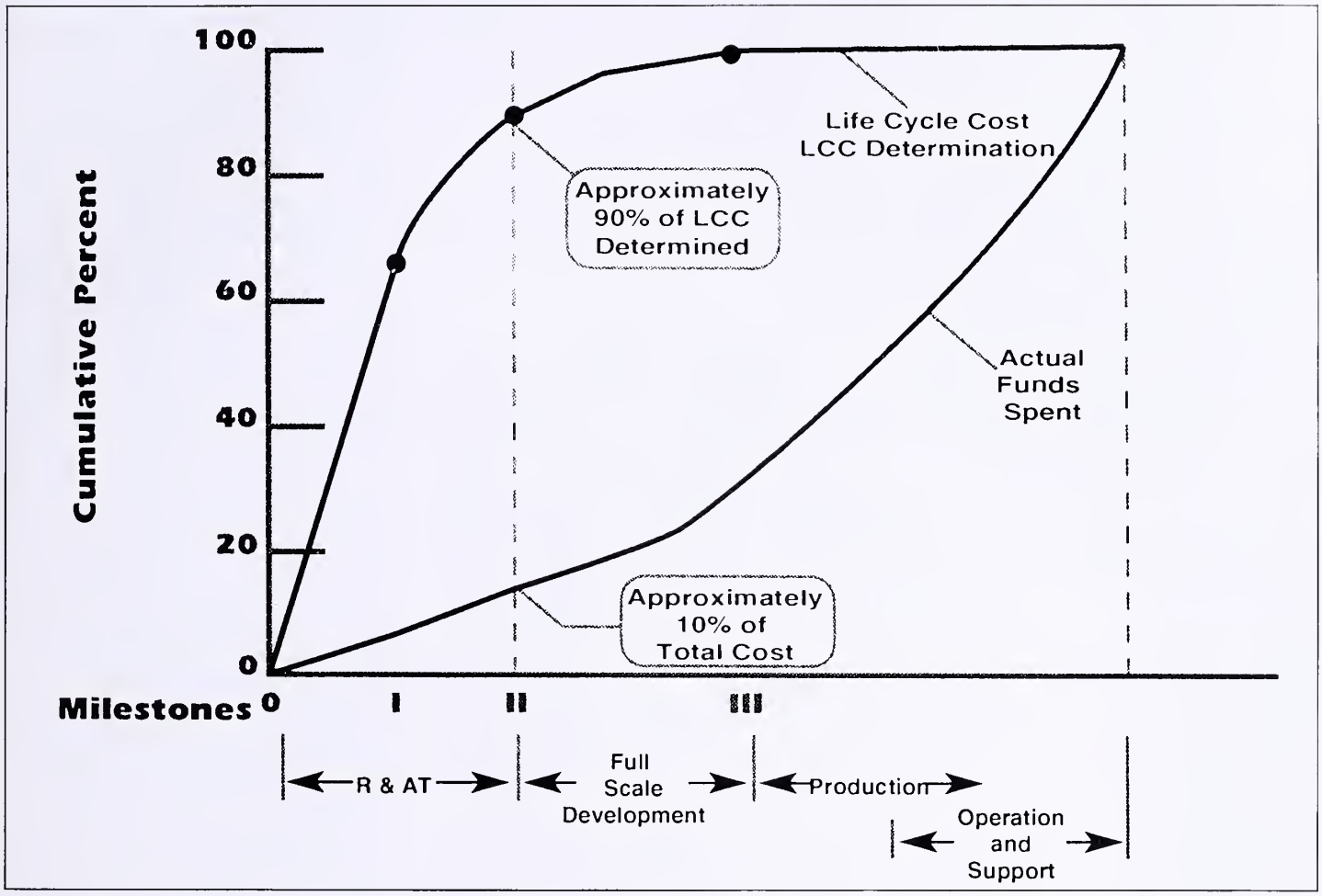


Figure 5.
Typical weapon system life cycle cost overview.

CATT will be comprised of multiple training simulators and simulations geographically dispersed at TRADOC schools and tactical units, and will be based on current weapon systems, configurations, tactics and doctrine. The Close Combat Tactical Trainer (CCTT) for armor/mechanized forces is under contract. The Aviation CATT (AVCATT), Air Defense CATT (ADCATT), Field Artillery CATT (FACATT) and Engineering CATT (ENCATT) are planned.

BDS-D will network low and high fidelity, real time, man-in-the-loop simulators at combat and materiel developer facilities. The FY92-94 BDS-D Advanced Technology Demonstration (ATD) is specifically focused on the networking of dissimilar simulators and simulations in a manned, combined arms environment. It will allow us to "fly before you build, buy or fight." Planned BDS-D ATD demonstrations include simulations of Line-of Sight Anti-Tank (LOSAT), Command Ground Station (CGS), Combined Arms Command and Control (CAC2), Combat Identification (CID), STINGRAY, and Rotorcraft Pilot's Associate (RPA).

The Army Simulation, Training and Instrumentation Command (STRICOM), Orlando, FL, was formed last year and is the Army's technical agent for DIS technology development and network management. STRICOM manages the CATT and BDS-D programs. STRICOM is also responsible for developing and maintaining the DOD/Industry modeling and simulation standards and protocols for DIS. A DIS Modernization Plan and a DIS Master Plan are in preparation and scheduled for HQDA approval during the second quarter of FY93.

Conclusion

The Army is adjusting for the post-Cold War era. To best shape the future Army, the Army leadership has initiated the Louisiana Maneuvers (LAM '94) and TRADOC Battle Labs, both of which depend heavily upon DIS as a portal into the future.

The May-June 1993 issue of the *Army RD&A Bulletin* will present a more in-depth discussion of some of the topics briefly addressed in this introductory article. These follow-up articles will offer user, developer and management perspectives from the DOD, industry and academic communities. In the interim, don't hesitate to call the DIS Functional Integrator's POC, Larry Cantwell, HQ TRADOC Analysis Command, DSN 552-2432, or the DIS Technical Integrator's POC, MAJ Robert W. Reed, STRICOM, (407) 380-4448, or, DSN 960-4448.

BATTELLE FORECASTS $162 BILLION FOR U.S. R&D IN 1993

Expenditures in calendar year 1993 for research and development (R&D) in the United States are expected to reach $162 billion, according to the annual forecast prepared by the Battelle Memorial Institute, Columbus, OH. This represents an increase of $4.6 billion (2.9 percent) over the $157.4 billion the National Science Foundation estimates actually was to be spent for R&D in 1992.

Since part of the R&D increase will be absorbed by inflation—estimated to be slightly more than 2.0 percent for 1993—Battelle forecasts a real increase in R&D expenditures of less than one percent. This is considerably less than the 10-year average increase of 3.1 percent in real R&D since 1982.

"The economy shows signs of an upswing, but not enough to stimulate a strong growth in R&D investments," said Battelle President and Chief Executive Officer Dr. Douglas E. Olesen. "The situation with the federal budget also will hold down spending.

"We are at the confluence of many different factors that impact on R&D expenditures. Shifting priorities in both government and industry, a slow business recovery, and a whole new spectrum of international opportunities and responsibilities have created uncertainties in R&D decision-making. However, the funding trend will be turning around. In order to meet future challenges in many other areas, we must invest in R&D, and in the capacity to utilize the results of research."

Sources of Funds

Industrial funding for R&D will account for 51.2 percent of the total. Industrial support is forecast to be $83 billion, up 2.4 percent from 1992.

Battelle sees an increase of 2.8 percent in federal support for R&D, with funding expected to be $70.1 billion. This is 43.3 percent of the total expenditures for 1993, but is a smaller increase than originally proposed in former President Bush's budget.

Funding by academic institutions is expected to be $5.7 billion (3.5 percent of the total), and other non-profit organizations will provide nearly $3.2 billion (2 percent).

Prior to 1980, government was the principal funder of R&D. But industry has been the dominant source of R&D support for the past 12 years, and that trend is expected to continue in 1993 and for the next several years.

Performers of Research

According to the Battelle report, industry will continue to perform the majority of R&D. In 1993, performance by industry is expected to rise to $112.7 billion, slightly less than 70 percent of all research. This compares with $18.2 billion (11.2 percent) by federal government laboratories, $25.5 billion (15.7 percent) by academic institutions, and $5.6 billion (3.5 percent) by non-profit organizations.

The federal government funds R&D in all four areas. About 45 percent of the federal R&D dollars are used by industry. The government and colleges and universities receive 25 percent each, and the rest, about five percent, goes to other non-profit organizations.

Industry uses almost all of its own funds, either performing the R&D itself or contracting with industrial researchers. Contracts and grants to non-profit organizations are about half of what is received by colleges and universities. (The figure used for colleges and universities does not include the support of long-range "endowed research" programs.) Non-profit organizations finance both themselves and academic institutions about equally; colleges and universities use their own funds.

Government Support

Defense, energy, space, and health and human services dominate the federal R&D scene and account for 89.2 percent of the total proposed federal R&D funding for 1993, which is essentially the same as in 1992. The makeup of this funding will not change significantly in 1993.

Changes in the character of military threats and an appreciation of domestic challenges have had a significant effect on the distribution of resources within the federal R&D budget. This change in emphasis among the principal research-intensive agencies is

	1993	1990	1987
Department of Defense	52.2	59.9	65.2
Health and Human Services (includes National Institutes of Health)	11.4	11.1	9.2
NASA	10.3	6.0	6.1
Department of Energy	15.0	9.3	9.8

Figure 1.

evidenced by a comparison of historical and planned expenditures, as noted in Figure 1.

The military continues to restructure—a trend that is expected to continue for a few years—and while this reorientation results in decreases in overall defense spending, there will not be a major retrenchment in defense R&D spending.

Several factors will influence federal R&D support: the continuing budget deficit, a swing toward reduction or curtailment of the so-called "big science" projects, and the emphasis on technology transfer and short-term projects that have industrial applicability. The overriding concern over the deficit is expected to prompt a reduction in growth of both defense and total government R&D, as was forecast in earlier Battelle studies. However, national security considerations will continue to be felt through advance research on programs that deal with surveillance and treaty verification.

It is particularly noteworthy that President Clinton's proposals relative to applied research are generally consistent with those forwarded by the outgoing administration. "Not surprisingly, additional funds will be directed toward research aimed at technologies that will enhance industrial competitiveness over both the long and the short term," said Battelle researcher Jules J. Duga, the forecast's principal author. "Continued concern over political changes in Eastern Europe and instability in the Middle East will influence R&D directions. But the federal government is also most likely to support research and institute policies that will strengthen domestic economic growth."

The emphasis on federal R&D funding as a means of supporting domestic economic growth is evidenced in three initiatives that are expected to continue.

- Funding for many of the so-called "big science" programs—including the superconducting supercollider and the space station—are under close scrutiny, with some of these barely escaping total cancellation or suspension.
- Efforts to reshape the basic research missions of the National Science Foundation and the National Institute of Standards and Technology are being made in an effort to direct resources toward more immediate applied research programs.
- Efforts at developing collaborations between industry and the federal laboratories are being pursued more vigorously.

Finally, with the urging of the scientific community, federal support of "pork barrel" science projects is coming under closer examination, and the practice of earmarking such funds is expected to be diminished.

Industrial Support

Industrial support of research will continue to grow in areas related to electronics, communications, sensors, advanced machinery, and in fields directly influenced by the need for more energy efficient products and processes.

Earlier versions of the Battelle forecast have detailed the division of federally and industrially supported R&D in broad industry classes. The 1993 forecast cautions against placing too much significance on the distribution of performance among the major industrial sectors. Such classifications do not take into account that many of the largest research-intensive companies have a wide spectrum of interests. Thus, available figures do not accurately represent the line-of-business distribution of R&D performance or the intensity of effort in specific areas of technology.

Special attention also should be given to the fact that estimates of industry performance and funding have undergone a significant change in recent years. Thus, when comparing earlier forecasts by Battelle or others, some inconsistencies will arise from a change in sampling techniques. It is important to recognize that the estimated figures for expenditures are far less important than the trends in R&D support and performance. The trends depict more accurately the influence of both government and industrial decision-making and priority-setting, each of which will have long-term impacts on the country's technology base.

In spite of significant changes in several major players, near-term

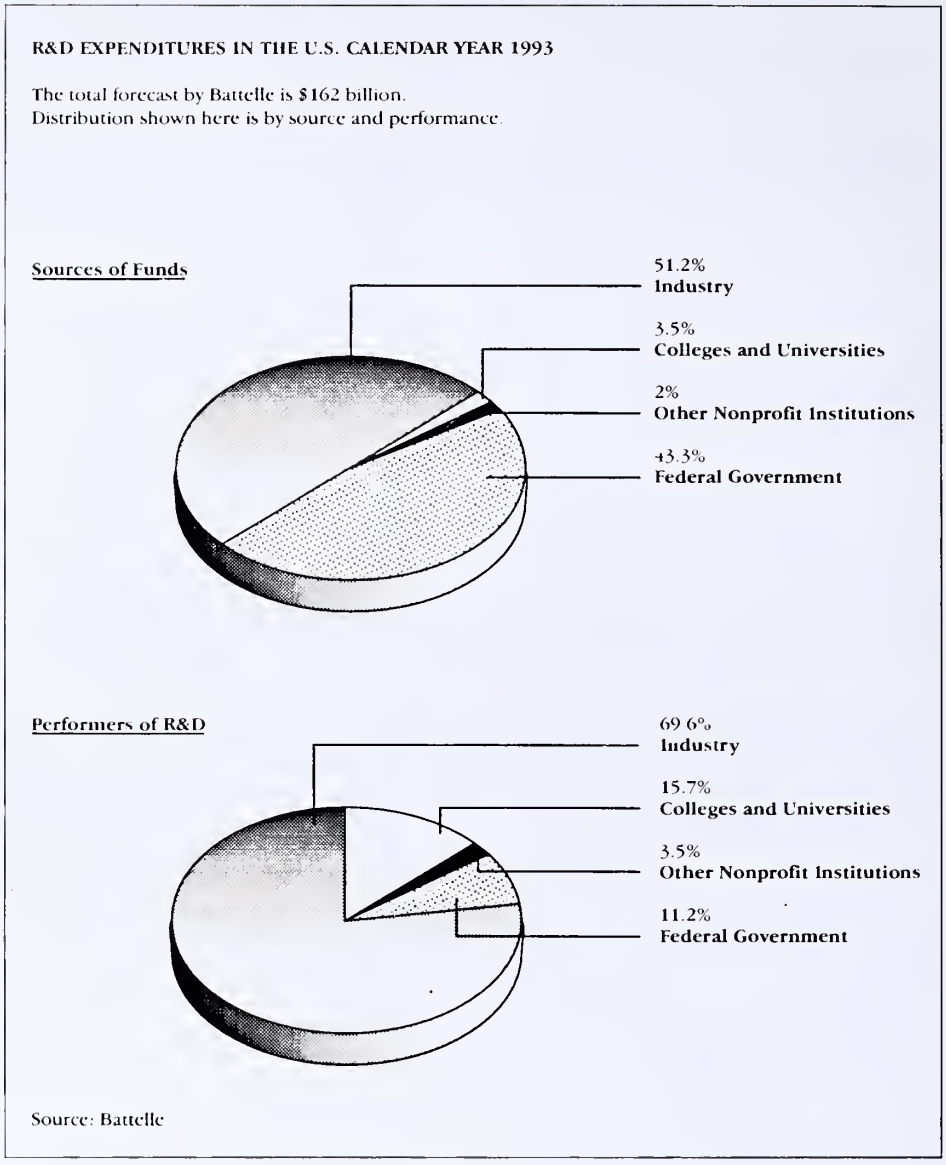


Figure 2.

industrial plans indicate that the slowdown in R&D growth may be stabilizing. Downsizing in all aspects of operations will have an adverse impact on R&D personnel levels. However, Battelle expects these moves to be offset by an increased interest in collaborative research programs. Furthermore, industrial postures in R&D spending will be influenced by the anticipation of a stronger federal government role in encouraging public/private partnerships, promoting permanent R&D tax credits, and enhancing the roles of the federal laboratories.

In addition, state governments continue to expand their roles and activities in support of a broad range of activities directed toward technology-based economic development and jobs expansions.

It is especially important to note that industrial support of R&D is accompanied by a greater concern for methods of evaluating R&D.

"Managers of industry are getting caught between contradictory pressures," Duga said. "Generally, R&D is not considered a direct revenue-producing activity and is often a candidate for the budget ax. On the other hand, they know R&D investment is vital for long-term profit and survival. Thus, as technology development, adaptation, and utilization become more important in all types of business, the role of the 'technology scanner and gatekeeper' become an increasingly important function.

"It's a balancing act for managers to define what is the right blend of R&D for an individual company," said Duga.

Long-Term Outlook

The R&D growth rate has been slowing and is expected to continue to decline, perhaps to the point of a ***decrease*** in real expenditures. A similar situation occurred two decades ago, with a very slow recovery. The Battelle forecast suggests that if there is a decrease in real expenditures, the real recovery will most likely occur more rapidly than before.

Industrial support will continue to be affected by conflicting and complex factors. Major changes in the traditional defense industries are forcing realignments within the industry, cut-backs in personnel, and stronger efforts toward definition of new markets—a situation not unlike that which beset the industry in the early 1970s.

The trade imbalance and efforts to correct it, as well as efforts to expand markets in response to shifts in government priorities, could spur expanded R&D. In addition, the internationalization of markets will influence R&D expenditures as U.S.-based companies attempt to accommodate the different regulatory postures and consumer behaviors in other parts of the world. Whether such initiatives will be fruitful will be influenced by the impacts of general slow-downs in worldwide economic growth and in the availability of foreign currencies.

In the recent past, the environment that permitted greater rewards for short-term financial results, rather than technological innovation, had an adverse effect on R&D investment. However, the tenor of the federal budget for 1993 and the pro-technology attitude of the incoming administration give reason for a cautious optimism regarding R&D growth and accountability in the near future.

The forecast for calendar year 1993 was prepared by Dr. Jules J. Duga, with assistance from Dr. W. Halder Fisher of Battelle. Parts of the data were drawn from the National Science Foundation reports, federal budget documents, the Industrial Research Institute, and other similar sources.

ARMY DATA DICTIONARY TECHNOLOGY

By SSGT. T. Anthony Bell

The Army's Information Systems Engineering Command (ISEC) is responding to the ever-increasing demand for data-sharing capabilities among existing Army management information systems.

ISEC's Information Systems Software Center (ISSC) at Fort Belvoir, VA, is pursuing data dictionary technology to address this demand, which has been fueled by Army standardization strategies. In the face of shrinking resources, these strategies emphasize greater efficiency largely through consolidation and interoperability.

Data dictionary technology being pursued by ISSC's Data Management Directorate supports Army standardization aims by giving existing systems a heightened level of versatility through the use of a companion "dictionary."

This electronic reference tool yields system-related data which is of considerable value to users, developers and designers of management information systems. Most important, this data can be shared with other management information systems, creating possibilities for interoperability.

One obvious way to show the value of data dictionary technology, according to Jim Glymph, the Army's data manager, is to apply it to the various Standard Army Management Information Systems (STAMIS). These systems, developed before the advent of dictionary technology, support the Army's personnel, financial, and logistical functions, but they operate vertically and cannot share information across functional lines.

"For example," said Glymph, "in the past, a pay system did not share data with a personnel system even though much of the data was the same or similar."

Furthermore, STAMIS produce redundate data files and inconsistent data among various functional applications. They are also prone to high software maintenance costs. Data dictionary technology remedies these problems, helping systems operate more efficiently.

The Army has shown a commitment to applying data dictionary technology not only to existing management information systems but to those not fully implemented. The Reserve Component Automation System (RCAS) is an example. This information system has so far produced more than 600 data standards for inclusion in the Army Data Dictionary (ADD). This means that users of management information systems Army-wide will have access to these standards and can use them in data-sharing applications. Additionally, the standards will help improve data accuracy within the system itself.

A centralized repository, the Army Data Dictionary is supported by a management information system called Automated Dictionary Support System (ADSS). ADD/ADDS is available through several networks and, according to Glymph, lets users "... create, change, delete, query, and maintain data elements and submit them for approval as Army standards."

The data element approval process is a measurement procedure. The Data Management Directorate reviews data for compatibility and adherence to procedural rules, and the information class proponent screens the data to determine whether it is functionally suitable for use Army-wide.

Glymph said that the Army data dictionary includes nearly 700 approved standard data elements, and hundreds more are awaiting approval.

The Army has planned a number of improvements and additions to make the ADD/ADSS more useful. These include an assistance facility that will, according to Glymph, "permit a user to query the ADD by entering a synonym of one or more words within a data element."

"Additionally," Glymph explained, "it will be possible to enter attributes about the data element other than words in the name. For example, a user can ask for all data elements that contain the word 'INDIVIDUAL' and are used in a specific automated system. This is called query by example. These features will give the user more flexibility and capabilities."

The ADD will eventually turn into the Army Data Encyclopedia when data models for all Army functional areas and more systems and organizations are added.

Currently, the Army Data Dictionary/Automated Dictionary Support System has more than 400 users and is growing. The system's use is an indication that it is adequately supporting the needs of the data management community, said Glymph.

"The future looks bright for the Army data management program as it provides long range support to the Army and DOD," he said. "It is a continuing process designed to provide the Army greater and better support for its information requirements."

The Department of Defense, eager to take advantage of data dictionary technology, directed Glymph's office to prototype a dictionary system of its own, the Defense Data Repository System, which became operational last August. This system will operate in an open systems environment and incorporate an approval process similar to that of the ADSS.

SSGT T. ANTHONY BELL is the NCOIC of the Public Affairs Office of the U.S. Army Information Systems Engineering Command (ISEC). Bell also serves as the editor of the Interface, ISEC's internal command publication. He holds an associate's degree in general studies from Cochise College, Sierra Vista, AZ.

Battle Labs Will Get It 'About Right'

The U.S. Army Training and Doctrine Command (TRADOC) has organized six battle labs to experiment with concepts and equipment to try to get it about right for a new power-projection American Army.

Current methods of determining requirements and setting priorities cannot keep pace, will not allow us to meet the budget challenges, will not allow us to maintain the edge, in this post-industrial era.

"Battle labs are an initiative analyzing capabilities and requirements rather than depending on concepts based on analysis and comparison against a firm threat, like we did in the Cold War. We can't depend on Cold War analyses and processes to determine priorities," notes GEN Frederick M. Franks Jr., TRADOC commander.

Since the end of the Cold War and the collapse of the Soviet Union and the Warsaw Pact, the U.S. military does not face one monolithic threat. Instead, there can be threats to American interests and allies from several sources.

Although some U.S. forces will be stationed overseas, the bulk of the American Army will be based at home. It will be a force-projection Army organized to protect national interests and assist allies. Operations Desert Storm in the Middle East and Just Cause in Panama are examples of the types of combat operations the Army envisions.

The six battle labs are: Early Entry Battle Lab at TRADOC Headquarters, Fort Monroe VA; Mounted Battlespace Laboratory (armor), Fort Knox, KY; Dismounted Battlespace Laboratory (infantry), Fort Benning, GA; Depth and Simultaneous Attack, Fort Sill, OK; Battle Command, Fort Leavenworth, KS; and Combat Service Support, Fort Lee, VA.

The Early Entry Lab will work with the Navy, Marines and Air Force to ensure initially-deployed forces are sufficiently large and lethal enough to be successful in any circumstance.

The battlespace labs will determine the best ways for armored and infantry forces to take advantage of time, distance and space on battlefields. The goal is to engage an enemy outside his range of capabilities, day or night, while dispersing Army forces but not their effectiveness.

At Fort Sill, the Depth and Simultaneous Attack Lab will work on ways to detect and simultaneously strike an enemy throughout the depth of the battlefield.

The Fort Leavenworth Battle Command Lab is developing techniques and equipment to give commanders at all levels situational information and intelligence to optimize their ability to command forces, particularly while on the move.

Combat Service Support Lab members are devising methods and systems to provide versatile, effective, and efficient logistics support at all levels.

"We've chosen to locate battle labs at our installations where we have soldiers, units and ranges for maneuver, firing, and air space," Franks said.

But before any concept and equipment are tried in the field by soldiers, battle labs will have tested them out through simulations and virtual prototyping, according to COL Bill Hubbard, director of battle lab integration and technology at Fort Monroe. "What battle labs allow us to do is bring together technologists, combat developers, materiel developers, industry and academia to build prototypes," Hubbard said. We then send it through simulation, bring it back again, tweak it, send it back through again to get a near optimum solution, or "about right."

"By using virtual prototyping we can look at different combinations of things on different pieces of equipment. Examples are what a new tank barrel can do on a tank, and what a new piece of armor on a tank will do," said Hubbard. He points out that the battle lab design will refine solutions on the front end of the acquisition process rather than on the tail end.

Battle lab task forces will work with industry to develop new technologies and equipment for the modern Army. However, Franks feels that, with budgetary situations, technological "insertions" will be the primary method used to enhance battlefield capabilities for the foreseeable future. Tech insertion means placing existing technologies on available equipment.

One tech insertion is the intervehicular information system (IVIS) in M1A2 Abrams tanks. IVIS allows armored forces to communicate digitally on the battlefield.

The Fort Knox lab has been looking at ways to expand IVIS to include aircraft, artillery and infantry to get the entire combat team on the same communications network. "You could spread your formations out some where you wouldn't have to mass the formation but you would continue to mass the effects of the fires," Franks said.

When IVIS prototypes have been made, soldiers and leaders will try them out in the field. "You can do virtual prototyping, but you want the opportunity with real soldiers out where we do what we do, out in the dirt, the wind, the rain and the night to do actual experimentation," Franks said.

As in the case of IVIS, each battle lab will not work in isolation. They will interact with major commands, units and laboratories throughout the Army.

Battle labs will also support Louisiana Maneuvers, the Department of the Army program to study capabilities and various preparedness issues. The maneuvers will be largely simulations built on top of current exercises used by warfighting commanders-in-chief.

"Although Louisiana Maneuvers will concentrate on the macro-level of mobilizing, deploying and sustaining an Army, a lot of attendant smaller issues will arise," Hubbard said. "Louisiana Maneuvers directors may want to know how a changed piece of equipment can affect outcomes of scenarios, for example. Battle labs can find out how that equipment will change the overall capabilities of an organization."

Battle lab task forces and the national scientific laboratories at Los Alamos and Sandia, NM, and Livermore, CA have agreed to exchange information, Hubbard said. He also pointed to advances in virtual prototyping at the University of North Carolina as a case of possible academia involvement.

Franks feels that a statement by Michael Howard, a British historian, describes what TRADOC and the Army are doing now: "When preparing for the next war, armies almost never get it totally right. But the real issue is not to get it totally wrong. What armies must attempt to do is get it nearly right before they again go into battle," Howard wrote.

What we need to do, inside TRADOC, is to continue to experiment in order for us to get it nearly right, Franks said.

TEC Supports Somalia Deployment

The U.S. Army Topographic Engineering Center (TEC), Fort Belvoir, VA, is currently supporting troops deploying to Somalia for Operation Restore Hope. This support includes providing tailored map products and other topographic and hydrographic data on the country.

On Dec. 2, 1992, TEC activated its Emergency Operations Center (EOC). The EOC is working with the Defense Mapping Agency to obtain all available digital data of Somalia.

TEC also is providing equipment, digital data and technical assistance to the 10th Mountain Division, Fort Drum, NY, in preparation for deployment. TEC personnel installed mobile computer equipment at Fort Drum which is capable of importing and using digital terrain data.

TEC's Field Support Office recently delivered equipment to the survey section of the 30th Engineer Battalion (Topo), Fort Bragg, NC, to help establish survey control in Somalia.

Because TEC is responsible for the Department of Defense water resources database, they were able to quickly provide water resources overlays and ground water information of Somalia for deploying units. As the leader of the Corps of Engineers' Water Detection Response Team, TEC's Terrain Analysis Center is preparing for possible deployment of a response team to give well-drilling assistance.

TEC has published and is distributing an environmental overview of Somalia produced by its Environmental Effects Branch titled, *The Manual of Environmental Effects, the Horn of Africa.*

Dozens of requests for support have been made to the EOC from deploying units and other supporting agencies. Requests range from questions on how to obtain a map, to information on water runoff and soil conditions in the country. To contact TEC's Emergency Operation Center, call (703) 355-2737 or DSN 345-2737.

DOD Selects Foreign Equipment for Tests

The Department of Defense (DOD) has selected 22 foreign military equipment candidates to be included in the FY93 Foreign Comparative Testing (FCT) Program.

Under the FCT program, selected non-developmental defense equipment produced by NATO and other formal allies, and by other nations considered friendly toward the United States, is tested and evaluated to determine whether such equipment satisfies DOD requirements or mission area shortcomings. Such evaluation is encouraged because a purchase of readily available foreign equipment may satisfy the requirements of the U.S. military services more quickly or at a more competitive cost than a full-scale U.S. research and development effort. The FCT program encourages competition. However, it is structured to ensure that U.S. manufacturers are not put at a disadvantage and that U.S. industrial base issues are considered.

Test and evaluation projects are nominated for consideration by the Services, which, upon approval, execute the testing efforts. Priority for FCT funding is for test and evaluation of non-developmental items in production or in the late stages of development. Additionally, testing of new hardware or emerging technologies may be conducted to assist in determining procurement alternatives.

Of the 22 projects selected by FY93 funding, 13 will begin in FY93, and nine are continuations of previously approved projects that started in previous years. Six are sponsored by the Army, eight by the Navy/Marine Corps, and eight by the Air Force. A brief description of each of the projects may be obtained by calling (703)697-5737.

Contract Calls for Smart Materials Technology

A 22-month, $265,853 contract for smart materials actuation rotor technology for helicopters has been awarded by the Aviation Applied Technology Directorate (AATD), Fort Eustis, VA, to McDonnell Douglas Helicopter Co.

"The objective of the program is to explore new developments in smart materials actuator technology which would support the development of a new notion for the main rotor and control system of future Army rotary wing aircraft," according to Donald J. Merkley, AATD project engineer. "Smart materials are materials that have the capability to respond to pilot inputs and sensors, by changing their shape and stiffness in a controlled manner."

These materials will be used to produce control actuators with few moving parts and be tolerant of the high vibration and centrifugal loading of the rotating blades of the main rotor. The benefits of using this type of actuators include improved rotorcraft performance, enhanced manueverability and agility, and reduced pilot workload and fatigue.

This program will survey smart materials technology as applied to actuator concepts, select appropriate smart materials for helicopter applications, perform trade-off analyses, design, fabricate and test proof-of-concept actuators in the operating environment of the helicopter main rotor.

Army Defense Communications Project Managers Selected

The Army Information Systems/U.S. Army Information Systems Management Activity (AIS/ISMA) has announced the selection of two new project managers.

COL James T. Doyle was named the project manager for Defense communications and Army transmission systems and COL Dennis M. Moen was named the project manager for Defense communications and Army switched systems.

Both will be responsible for major projects that are revitalizing the information transfer infrastructure that will help the downsized Army of the near future to project power.

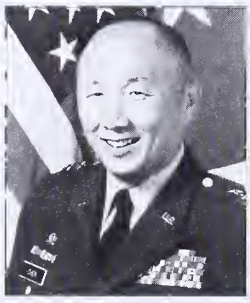
Moen will manage projects including the Army's Major Command Telephone Modernization Program, Defense Message System-Army Project, Automated Dial Service Assistance Project, Army Small Computer Program and Army segments of the Joint Service Computer Program.

Before coming to AIS/ISMA, Moen most recently served for a year as the deputy director of the Planning, Program Analysis and Evaluation office of the Defense Information Systems Agency.

Doyle will manage projects including the Fort Belvoir, VA, Information Mission Area Modernization and the White Sands, NM, Missile Range Test Support Network.

From 1987 to 1991, Doyle was the Army's project manager for operations tactical data systems.

What Role Does Education and Training Play in the Professional Development of Army Acquisition Corps Members?



MG William S. Chen
Program Executive Officer
Global Protection Against Limited Strikes
Arlington, VA

Education and training play a very important role in the professional development of Army Acquisition Corps members. But, education and training are elements in the total development of acquisition leaders and managers. In my opinion, that total development should be based more on experience in a variety of and in progressively responsible program management and acquisition management assignments.

Acquisition Corps members need education and training in terms of graduate school, specialized functional courses, and program management instruction. I believe there needs to be a hierarchy of education and training for Acquisition Corps members consistent with their level of responsibilities. The Program Management Course, obviously, should be a goal for all aspiring program managers, functional division chiefs within a program office, as well as heads of functional organizations providing matrix support. In general, however, nobody immediately becomes a program manager. PMs generally come from some functional area of expertise like engineering, program control, logistics, procurement, or other discipline. Therefore, early-on in one's professional development, some basic functional area expertise must be developed. This expertise gets developed through formal education and training, as well as through expertise.

There is no magic prescription for success in acquisition. I acknowledge the need for education and training, but I also subscribe to the importance of hard-core acquisition experience. Many who have excelled in the academics of acquisition disciplines could hardly be effective as leaders and managers. Many who are successful acquisition leaders and managers, probably lack all the desired schooling in program/acquisition management. Ultimately, what leads to advancement and what's important for total professional development is the factoring of other attributes—leadership, communications skills, ability to motivate, personality, integrity, and the right chemistry within the organizational framework.



Dale G. Adams
Program Executive Officer
Armaments
Picatinny Arsenal, NJ

Today, the acquisition business is extremely complicated and fraught with chances to make major mistakes. It takes a true professional to succeed as an acquisition manager in today's turbulent, scarce resource environment. Education and training are critical to the proper development of a professional acquisition manager, whether civilian or military.

Based on my experience, let me highlight some areas where formal education and training make a difference:

- **Understanding the Program**—having the ability to grasp the technology, or technologies, used in the program is critical to being able to assess needed actions and its attendant risks. Lack of technical understanding often leads to oversimplification of essential issues and thus improper decisions. What follows next is schedule delays and cost increases that cannot be managed within existing resources and milestones.
- **Overall Program Management**—the basis of managing a program and the tools for use are well known. Formal education and training programs (i.e., graduate studies, the Defense Systems Management College, the Program Manager's Course, the Materiel Acquisition Management Course, ICAF, etc.) can provide the bag of tools any acquisition manager will need to successfully manage a program. Understanding and applying the basics of program management is essential for success.
- **Practical Experience**—programs such as Training With Industry, developmental assignments, rotational project and test engineers, etc., provide the hands-on experience needed to see how the business of acquisition is really conducted. This is where the acquisition professional will hopefully develop some "common sense" and learn to apply the more formal education and training programs to real world problems. Sequential education and training, intertwined with developmental assignments that incorporate increasing responsibilities is the key to developing a successful acquisition manager. In my view, if there is one segment of acquisition professional development that should be expanded it is the area of developmental assignments. However, care must be taken to preclude assigning a person to a developmental position without the necessary education and training to perform the job.

Today's acquisition business is far too complicated to be managed by amateurs. Training and education provide the foundation to transform the amateur into a professional. If we want the professionals, we must make the investment.

SPEAKING OUT



BG Orlin Mullen
Program Manager
Comanche
St. Louis, MO

The Army's future Acquisition Corps must have experienced and dynamic leaders. But, leadership and management abilities will be of little value without a thorough understanding of the technical skills demanded by a very complex acquisition process. The Army and the Department of Defense offer the special schools and college opportunities for professionals interested in acquiring the basics. The next step is on-the-job training in an acquisition development position. In addition, the Acquisition Corps offers great opportunities for attendance at civilian universities or senior service colleges as a means toward further development of aptitudes and skills valued for advancement in both civilian and military acquisition management. The unparalleled opportunities include long-term and part-time graduate studies, fellowship programs and tuition reimbursement programs. The acquisition professional can define personal skills to support a career progression of increasing responsibilities. These career opportunities will deliver tangible and substantial rewards from seeing real contributions to the Army's mission and to our soldiers. During these times of diminishing resources, this is truly a unique opportunity for self-development and service to the nation. The acquisition professional can lead by example, in providing the material edge to the best trained and best led fighting force in the world. The keys to success are a commitment to service and a drive to develop thorough education and experience the professional competencies required by the Acquisition Corps professional.



Carolyn S. Thompson
Chief, Program and Acquisition Management Division
Anti-Satellite Joint Program Office
U.S. Army Space and Strategic Defense Command

When one thinks about the genesis of the Acquisition Corps, it is quite easy to understand why the answer is "Everything." One finding of both the Packard Commission and the Defense Management Review was that the acquisition of major defense weapon systems simply costs too much. It was hypothesized that one way to help lower the costs of acquiring those weapon systems would be to have a cadre of highly trained and educated personnel charged with the responsibility of acquiring all materiel needs for our armed forces. Our U.S. Congress accepted those reports and legislated statutes commensurate with the findings and recommendations.

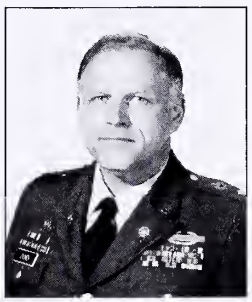
Therefore, the Department of Defense has implemented the statutory requirements for a highly trained and educated workforce by developing a progressive career development program for all acquisition workforce career fields. This program consists of mandatory standards for education, training, and experience for all grade and performance levels of each career field.

What does all this mean to the individual in the trenches? If an individual's position has been determined to be an "acquisition position," then education and training become **THE** most important things to look at in terms of career advancement. If the position has been determined to be an acquisition position and is classified at a grade of 14 and above, it automatically becomes a "critical acquisition position." Therefore, there are even more stringent education and training requirements imposed on the critical acquisition positions. By definition, all Acquisition Corps members are GS/GM 13 and above, and will be competing for all "critical acquisition positions."

In accordance with DOD directives, all career fields within the acquisition arena have been subdivided into three levels, based upon grades, with Level I being the lower grades and Level III covering the highest grades. Beginning in October 1993, each person will have to meet all training, education and experience standards, as specified by the DOD directives, before progressing from Level I to Level II and from Level II to Level III, i.e, getting promoted. For recruitment to acquisition positions, the education, training, and experience standards will be used as ranking factors. Again, the answer to the original question, "What role does education and training play...": EVERYTHING.

The **GOOD NEWS** in this is that the individual in the acquisition workforce and those in the Acquisition Corps have tremendous resources on which to draw now to receive the needed training and education. The Army has established a very impressive listing of recommended courses at various colleges and universities, as well as government sponsored courses. The government will now pay for an individual to go back to school to get a degree, both undergraduate and graduate degrees. Heretofore, the government would only pay for education and training which would "help the individual better perform his/her present duties."

With the "downsizing" of the Department of Defense and the shrinking defense budget, all indicators say that education and training are **THE** big role players in the professional development of all Army Acquisition Corps members.



LTC Daniel D. Ziomek
Dean, School of Acquisition Management
U.S. Army Logistics Management College
Fort Lee, VA

I believe, in general, the Army has done a reasonable job historically of emphasizing training and education as part of any professional development program. There have been some exceptions to this general rule. The Army has recently placed increased emphasis on leadership development for our civilian workforce, an area of professional development that the Army recognized as having been neglected. Another area needing renewed focus was the acquisition workforce. Under the auspices of the Defense Acquisition Workforce Improvement Act (DAWIA), the Army, along with all of DOD, has begun to rectify historic problems with the professional development of personnel in acquisition positions.

We are beginning to see the results of that renewed emphasis on training acquisition professionals here at the School of Acquisition Management (SACM). Even while the Army and DOD are downsizing, the number of students attending Defense Acquisition University (DAU) sponsored courses conducted by SACM will grow in 1993.

Both DOD and the Army recognize that timely training and education is the cornerstone of a truly professional Acquisition Corps. What is more important is the fact that, in a time of diminishing resources, we are demonstrating our commitment to professionalism by properly resourcing that training. We work in a fast moving, demanding, and highly technical environment. To succeed in that environment, the professional development of the Acquisition Corps will continue to depend on competency based, timely, and continuous education and training.

Army Acquisition Workforce Tuition Reimbursement Program Selectees

The following is a list of members of the Army Acquisition workforce selected for the Tuition Reimbursement Program.

Name	Organization
Abram, Iona	AMC
Akins, Marsha	AMC
Alesandro, Cynthia	PM, PALADIN
Ames, Lois	FORSCOM
Anderson, Alice	TRADOC
Andrews, Carol	AMC
Appleton, Charles	COE
Ashton, Sheila	AMC
Austin, Deborah	FORSCOM
Bair, Tammy	AMC
Baker, Glenn	FORSCOM
Baker, Wannett	AMC
Barnett, Brenda	AMC
Barr, James	COE
Bastian, Catherine	AMC
Beck, Linda	FORSCOM
Beharrie, Pamela	MDW
Bergener, Susan	AMC
Berkowitz, Shirleyan	AMC
Berns, Helen	USAREUR
Beverly, Edwonia	FORSCOM
Binford, Victoria	AMC
Blackstone, Donna	ISC
Blesi, Diane	HQDA
Bogan, Diane	FORSCOM
Boston, Ronald	AMC
Boswell, Robert	AMC
Bowen, Mary	AMC
Boyd, Carmen	AMC
Bracken, Patricia	AMC
Brock, Susan	AMC
Brooks, Gene	AMC
Brown, Barbara	8TH USA
Brown, Teresa	AAESA
Buchanan, Patricia	HQDA
Burer, Bonnie	TRADOC
Burke, Kathleen	AMC
Bush, Margaret	AMC
Calcote, Glenda	FORSCOM
Carsey, Linda	AMC
Carter, Phillip	AMC
Caudle, John	AMC
Chew, Angela	AMC
Christianson, Lisa	COE
Clark, Angela	AMC
Clements, Gail	AMC
Cole, Elva	FORSCOM
Colegrove, Hermon	FORSCOM
Coleman, Barbara	ISC
Concilio, Dawn	AMC
Cook, Cynthia	AMC
Cook, Earl	TRADOC
Corley, Pamela	AMC
Cornett, Eugene	MDW
Cote, Mary	AMC
Cowan, Vickie	AMC
Cowman, Charlene	TRADOC
Creviston, Charles	COE
Cruz, Wanda	COE
Cuffaro, Ingrid	AMC
Curran, Tookie	AMC
Darry, Deborah	MDW
Deem, Betty	COE
Deluca, Cheryl	AMC
Dery, Theresa	AMC
Delvin, Claire	PEO ARM
DeSousa, Rose	AMC
Dingman, Eileen	AMC
DiGuarto, Mark	COE
Dooley, Rita	AMC
Dresch, Edith	TRADOC
Duchane, Rosemary	AMC
Duerinck, Sandra	PEO COMM
Dwyer, Mary	AMC
Eagle, Joetta	TRADOC
Elvetici-Baltzell, Tammy	MDW
Engel, Donald	AMC
Erskine, Gladys	AMC
Eveker, Clare	AMC
Fenner, Virginia	AMC
Fitch, Lela	AMC
Fleming, Dorothy	FORSCOM
Fleming, William	COE
Flores, Sylvia	FORSCOM
Floyd, Felicia	MDW
Forbes, Deborah	AMC
Forgett, Nancy	AMC
Foster, Myrna	AMC
Frank, Yunkyong	INSCOM
Frazer, Russell	AMC
Furlow, Helen	HQDA
Gallagher, Karen	FORSCOM
Gann, Carol	PEO COMM
Garcia, Diana	FORSCOM
Garcia, Sharon	AMC
George, Sally	AMC
Goncalves, Rita	COE
Gonzaelz, Sharon	AMC
Goodell, Geraldine	AMC
Gowen, June	FORSCOM
Gratto, Shirley	TRADOC
Green, Kim	AMC
Greene, Beverly	MDW
Griffin, Deborah	AMC
Guins, Norma	FORSCOM
Gustum, Laurie	COE
Hall, Cynthia	FORSCOM
Halls, Roberta	AMC
Hamilton, Carla	AMC
Hancks, Janet	COE
Harmonson-Walls, Diana	HSC
Harris, Gloria	COE
Harris, Laura	AMC
Hatfield, Doris	FORSCOM
Hembree, Karen	AMC
Henderson, Linda	8TH USA
Heyn, Cathleen	PEO CCS
Hicks, Renee	COE
Hincapie, Lisa	COE
Hinds, Chele	AMC
Hobson, Winifred	AMC
Hodge, Jacqueline	AMC
Hoffman, Debra	AMC
Holloway, Angela	TRADOC

CAREER DEVELOPMENT UPDATE

Name	Organization
Hoyt, Betty	AMC
Hubbard, Mary	AAESA
Humphries, Denise	COE
Jackson, Cheryl	HSC
Jackson, Madeline	PEO AVIATION
Jackson, Mary	FORSCOM
Jacobs, Angela	FORSCOM
Jaggers, Elvia	AMC
James, Trudy	COE
Jennings, Vivian	AMC
Johanson, Rhonda	COE
Johnson, Amanda	FORSCOM
Johnson, Margaret	AMC
Johnson, Melanie	AMC
Johnson, Patsy	AMC
Johnson, Robin	AMC
Johnson, Rosalyn	AMC
Jones, Cynthia	FORSCOM
Jones-Wright, Michele	AMC
Kaneshiro, Julius	COE
Kapso, Monica	AMC
Keck, Sherilyn	AMC
Keeling, Michael	FORSCOM
Kelly, Vernice	FORSCOM
Kemp, Anthony	MTMC
Kendig, Marjorie	TRADOC
Kewer, Michelle	COE
Knight, Donna	TRADOC
Kolosvary, Karen	HQDA
Krahl, Janice	COE
Lambert, Linda	HQDA
LaSalle, Roxanne	FORSCOM
Lavoie, Nathalie	FORSCOM
Lewis, Sheila	AMC
Lewis-Goss, Patricia	AMC
Lindler, Tyndal	MTMC
Lioy, Betty	AMC
Longaza, Paz	FORSCOM
Love, Mary	AMC
Lozupone, Ann	AMC
MacLean, Laura	AMC
Magnusson, Constance	AMC
Malinowski, Frances	AMC
Malvik, Wanda	AMC
Mance, Patricia	AMC
Marten, Linda	FORSCOM
Martin, Donna	AMC
Mata, Laura	FORSCOM
Maudlin, Lynn	TRADOC
McBride, Warren	FORSCOM
McCullough, Mary	AMC
McFadden, Rosalind	FORSCOM
McGregor, Suzanne	AMC
McIntyre, Carol	COE
McKellery-Thorne, Edna	HQDA
McNeiley, Rebecca	COE
Mechals, Susan	COE
Meeks, Karyn	COE
Mesa, Susan	AMC
Middleton, Sherry	FORSCOM
Milan, Martha	MDW
Miles, Janice	FORSCOM
Millhouse, Kenneth	FORSCOM
Milton, Pamela	AMC
Moats, Carol	ISC
Moncada, Maria	HSC
Montgomery, Victoria	COE
Moore, Bertha	HSC

Name	Organization
Moxham, Elvira	COE
Murray, Kristi	FORSCOM
Murray, Mallory	AMC
Murray, Roy	FORSCOM
Myers, Lenore	AMC
Nakasone, Keith	HSC
Nappi, Jerry	PEO COMM
Nevels, Pamela	AMC
Newby, Susan	FORSCOM
Newell, James	HSC
Newhart, Phuong	HQDA
Nichols, Dolores	AMC
Nickel, Patricia	AMC
Nissen, Anette	AMC
Nix, Christie	AMC
Norman, Linda	AMC
Norwood, Linda	AMC
Nosar, Sherri	HQDA
Novak, Rae	AMC
Nowakosdki, Donna	AMC
O'Conner, Margaret	AMC
Ortiz, Maria	HSC
Oswald, Dawn	FORSCOM
Owens, Barbara	TRADOC
Paisley, Christi	AMC
Pannunzio, Daniel	AMC
Parton, Sara	COE
Patrick, Sharon	AMC
Peterson, Janice	FORSCOM
Phillips, Patricia	AMC
Pitts, Gail	AMC
Pitts, Lana	AMC
Pleasant, Cynthia	COE
Pool, Teresa	FORSCOM
Porcincula, Rose	MTMC
Poston, Camilla	AMC
Potts, Michael	PEO CCS
Powell, Kerry	COE
Pradaxay, Khanida	COE
Pratt, Carolyn	PEO COMM
Priest, Catherine	COE
Ramos, Teresa	HQDA
Ramsey, Florence	MDW
Randall, Roger	AMC
Rapp, Debra	FORSCOM
Rasmussen, Sylvia	COE
Reed, Elizabeth	AMC
Reed, Kristan	AMC
Reeve, Rose	FORSCOM
Reynolds, Brenda	AMC
Rhorer, Clifford	AMC
Rifkin, Kathy	COE
Ritchey, Valorie	AMC
Roahrig, Lynn	FORSCOM
Robbins, Mary	AMC
Robertson, Patricia	MDW
Rogers, Susan	COE
Ross, Shirley	FORSCOM
Sampsell, Nancy	PEO IEW
Sawchak, Debra	AMC
Schiewe, Linda	FORSCOM
Schomp, Peggy	PEO ARM
Schultz, Kathleen	COE
Scretching, Gwendolyn	AMC
Self, Sandra	AMC
Selwyn, Virginia	COE
Simmons, Connie	AMC
Simons, Rita	AMC

Name	Organization
Sims, Kimberly	COE
Sinclair, Mary	AMC
Sitz, Ellen	AMC
Skeeters, Donna	TRADOC
Skupin, Rosemary	AMC
Sloan, Martha	FORSCOM
Smith, Carolyn	AMC
Smith, Learah	FORSCOM
Smith, Ruth	AMC
Sorochen, Debra	AMC
Spady, Janice	FORSCOM
Spurgetis, Roxanne	AMC
States, Patricia	AMC
Stephens, Sheryl	COE
Storkel, Bernadette	FORSCOM
Street, Diane	AMC
Stroinski, Jeanne	FORSCOM
Surgeon, Rita	AMC
Tabor, Rebecca	AMC
Takeguchi, Wendy	FORSCOM
Tate, Tracie	AMC
Taylor, Maureen	COE
Tebben-Cooper, Myrna	COE
Tellez, Hortensia	AMC
Thomas-Lawson, Robin	AMC
Thomas, Darlene	AMC
Thomas, Melissa	HSC
Tighe, Margaret	AMC
Titus, Judith	AMC
Todd, Jean	FORSCOM
Tomaine, Lucille	ISC
Tonkin, Michael	AMC
Topp, Connie	TRADOC
Torre, Vivida	FORSCOM
Trexler, Michael	NGB
Trice, Stanley	PEO IEW
Troia, Emily	AMC
Trubilla, Nancy	COE
Tuck, Peggy	FORSCOM
Twyford, Gary	AMC
Tyler, Carla	AMC
Usry, Margie	TRADOC
Uthoff, Judith	AMC
Valin, Karen	AMC
Valleroy, Lesa	AMC
Van Collie, Linda	ISC
Vincenti, Julia	AMC
Vires, Janette	FORSCOM
Voss, Barbara	COE
Walker, Johnny	PEO GPALS
Warfield, William	AMC
Weiss, Bonnie	COE
Wheeler, Laura	TRADOC
White, Velma	HSC
Whitfield, Bettye	AMC
Whittaker, Sharon	AMC
Wilder, Kathleen	AMC
Willhite, Lucinda	AMC
Williams, Donna	MDW
Williams, Patricia	FORSCOM
Wilson, Saint	HQDA
Winston, Sheila	AMC
Winters, Mary	AMC
Wise, Ronald	AMC
Wise, Shirlene	AMC
Wohlin, Wanda	PEO COMM
Woodard, Alondria	COE
Woodsmall, Joanne	AMC
Worsham, Theresa	FORSCOM
Wyatt, Kathleen	FORSCOM
Zurick, Teresa	TRADOC

Army Acquisition Corps Training and Education Selectees

The following is a list of AAC members selected for attendance at Army Acquisition Corps executive seminars, long-term graduate studies, and Tuition Reimbursement Program.

EXECUTIVE SEMINARS

	Organization
Harvard University	
Edgar, James	HQDA
Jeffres, Suellen	HQDA
Thompson, Carolyn	SSD
Friar, Glenn	AMC
Wharton	
Bramwell, Barry	AMC
Gann, Rex	PEO COMM
Grysiewicz, Joseph	AMC
Hyderman, Art	AMC
Kahn, Stanley	AMC
Kirkwood, James	AMC
Manzione, John	AMC
Notte, Gary	AMC
Patel, Anil	COE
Wise, Elizabeth	PEO GPALS
Hoffman, Thomas	PEO ARM
Williamson, R.	7th Sig
The Brookings Institution	
Adams, Dale	PEO ARM
Bednarik, George	AMC
Dominiak, Mary	AMC
Laibson, Lawrence	AMC
Noblitt, R.	AMC
Radkiewicz, R.	AMC
Streilein, James	AMC
Weller, David	AMC
Cavender, Jerry	PEO GPALS
Sherer, Alan	PEO GPALS
Frank, Deborah	PEO COMM
Jenkins, Hellen	SSD
Lakey, Charlotte	PEO STAMIS
Mullinix, Jerry	COE
McGovern, William	AMC
Center for Creative Leadership (CFCL)	
Blomquist, John	AMC
Hopkins, Homer	AMC
Luckan, Susan	AMC
Wesson, Wayne	AMC
Wilson, Jerry	AMC
Wilson, Robert	AMC
Montjar, Janet	AMC
Ronan, Patricia	AMC
Thakur, R.	AMC
Schaefer, Susan	INSCOM
Andrejkovics, Richard	PEO ARM
Stern, Eric	PEO COMM
Martin, Warren	PEO GPALS
Lee, Daewoo	PEO IEW

CAREER DEVELOPMENT UPDATE

	Organization
Office of Personnel Management (OPM)	
Coogan, Jack	AMC
Golden, Robert	ISC
Luckan, Susan	AMC
Luedeke, James	HQDA
Smalley, Lavelle	PEO Tact Msl
Butler, Robert	AMC
University of Texas at Austin	
Moreo, Dominick	AMC
McKechnie, Robert	AMC
Bendall, Doris	AMC
Malooly, Fayez	PEO ARM
Nalley, Donald	PEO Tact Msl
Payne, Gordon	AMC
Sayne, Martin	AMC
Scott, Earl	AMC
Jones, James	AMC
Batchis, George	PEO ARM
Duke University	
Malatesta, Edward	AMC
Sparks, Richard	AMC
University of Virginia	
Butler, Sharon	AMC
Gaines, Toni	FORSCOM
Holmes, Dana	AMC
Jenkins, Helen	AMC
Maples, James	AMC
Latson, Lynda	AMC
Livingston, Aubry	AMC
Meyer, Thomas	AMC
Otto, John	AMC
Rivard, George	AMC
Wood, Andrew	AMC
Fox, Clarke	AMC
University of Michigan	
Bazzy, Richard	AMC
Powell, William	AMC
University of Chicago	
Cappetta, Fred	AMC
Cherry, Gene	AMC
Lombardo, Santo	AMC
Pieplow, Thomas	AMC

LONG TERM GRADUATE STUDIES

Easton, Patrick	AMC
Carlisle, George	COE
Chambers, Joe	SSD
Ward, Kay	SSD
Novad, Joseph	AMC
Vytlacil, Theodore	PEO AVN

TUITION REIMBURSEMENT PROGRAM

Fix, Edwin	AMC
Marcinkiewicz, Ed	AMC
Strollo, Carmen	PEO COMM
Turner, Mary	PEO COMM
White, William	PEO ASM
Hollern, James	AMC
Shultz, Ronald	7th Signal
Lee, Harvey	AMC
McGlone, Sally	AMC
Wolfinger, Janet	HQDA
Powell, Joanne	PEO COMM

Colonel Promotion Results

Congratulations to the following Army Acquisition Corps (AAC) lieutenant colonels who were recently selected for promotion to colonel. Overall AAC selection rate was 55.7% compared to the Army's average of 44.3%.

NAME	FA	BR
ADAMS, Charles J.	97	OD
ARMBRUSTER, Robert E.	51	MI
ARROL, Lawrence G.	53	MI
BROWN, Fred E.	51	AV
CARDINE, Christopher V.	51	AR
CASTO, Perry C.	51	AD
CHRISCO, Larry D.	97	QM
CLAGETT, David C.	97	QM
COGAN, Kevin J.	51	SC
DAVIS, Frank C. III	97	OD
GRIMES, Walter B.	51	OD
HARRINGTON, Edward M.	97	QM
HOWELL, Michael I.	51	AD
KERRINS, Richard D.	97	FI
KNOX, William D.	51	AD
LANE, Howard M.	51	IN
MCGAUGH, Dennis A.	51	MI
MCKAN, James	51	SC
MOORE, James R.	53	SC
MORIN, Dennis W.	97	AD
NAKAGAWA, Dean R.	51	SC
OLDHAM, Robert W.	51	SC
OLER, Roy P.	51	AV
OLIVER, Randall G.	51	AV
PAWLICKI, Raymomd	51	OD
PETTERSON, Maurice E.	97	OD
PRICE, Morris E.	51	IN
PULSCHER, William R.	97	OD
REES, Chester L.	51	AV
REYNOLDS, James C.	51	AV
SHEAVES, William B. III	51	FA
SHIVELY, Robert G.	51	SC
WALLEN, David A.	53	AD
WANK, James A.	51	EN
WESTRIP, Charles W.	97	QM
WHITE, Philip O.	51	OD
WOLFGRAMM, Paul E.	51	SC
YAKOVAC, Joseph L.	51	IN

THE DOD SCIENCE AND TECHNOLOGY STRATEGY

Editor's Note: The following perspective on the DOD Science and technology strategy was provided by the Electronic Industries Association (EIA), a national trade organization representing U.S. electronics manufacturers.

"The Director of Defense Research and Engineering (DDR&E) has made a good start in putting forward a new Science and Technology (S&T) strategy, but there is much uncertainty as to the ultimate success of this new approach to technology development," according to the Electronic Industries Association (EIA). The new strategy and its implications to industry were discussed at the EIA 28th Annual 10-year Forecast Conference of Defense Electronic Opportunities, held late last year in San Diego, CA.

The new strategy is aimed at focusing technologies in support of five capabilities or thrusts based on worst-case Desert Storm warfighting needs extended to the early part of the next century. The S&T efforts come together at the 6.3A budget program level with emphasis on high payoff (high leverage) Advanced Technology Demonstrations (ATDs). The five warfighting thrusts are Global Surveillance and Communications (Thrust 1), Precision Strike (Thrust 2), Air Superiority and Defense (Thrust 3), Sea Control and Undersea Superiority (Thrust 4), and Advanced Land Combat (Thrust 5).

"The FY 1994 POM cycle is critical for judging the long-term impact of the new strategy with issues such as service alignment of their S&T efforts with the thrusts and the establishment of formal links to SDIO very much up in the air," said Geoffrey Bentley, manager of Business Research at Textron Defense Systems in Wilmington, MA. According to Bentley, industry and the services are also very skeptical about how much technology will actually transition from advanced development to acquisition since the exit criteria for moving good systems and related prototypes to latter stages of development and production versus shelving them are not yet defined. Bentley commented "It is all well and good to talk about shelving technology until the need arises, but how do you maintain a profitable and viable research and supplier base in the meantime?"

Bentley said that the really new aspects of the strategy are the involvement of the user through simulation (Thrust 6, Synthetic Environments) and the assurance of producibility and affordability (Thrust 7, Technology for Affordability) at every step of the way. "Simulation and modeling is the one new initiative that will stay regardless of the acceptance by the services of greater direction and control by DDR&E of their S&T programs. Simulation is a certain growth area and the message to industry is to get on the Defense Simulation Internet and participate in the evolving world of synthetic environments."

The new approach to S&T means that most R&D efforts will be shaped by a strong top-down capabilities-pull incentive rather than by a balanced technology advancement program that has characterized efforts in the past. With diminishing budget resources and no clear military technological challenges on the horizon, science and technology can focus on incremental improvements in weapon systems and use simulation to test the military viability of each upgrade and use producibility measures to assure affordability of proposed upgrades without actually moving systems to full production. The emphasis is on technology insertion and the key to success is integration across systems, services and thrusts.

Bentley reminded the audience that there has really been no change in the S&T funding procedures. The top-level demos or ATDs must be based on real service or Defense Advanced Research Projects Agency (DARPA) programs—the DDR&E or the thrust leaders under DDR&E direction do not explicitly fund the efforts.

Industry must still interface with the service-user community and the service lab/DARPA technology community to understand the problem and proposed solution for each mission and function of interest. Nevertheless, the DDR&E does have expanded powers to exert leadership, according to Bentley. He cited Deputy Secretary of Defense Atwood's memo of August 1991 strengthening the technology and acquisition functions of DDR&E, the creation of a Defense Technology Board chaired by the director to sanction ATDs above a certain threshold, and the use of a Defense Technology working Group or 'Breakfast Club' to achieve consensus among DDR&E, services and DARPA.

Bentley mentioned that the Precision Strike ATDs of Artemis and Warbreaker are good examples of how the process works using real programs (e.g. JDAM for Artemis) and involving different services and agencies. Funding for each of these top-level demos may average $100 million a year over a 10-year period.

Bentley also discussed the characteristics of the entire S&T effort including 6.1 research program, 6.2 exploratory development programs and 6.3A advanced development programs. The billion dollar a year research account has a strong laboratory constituency.

There has been some discussion of making the research efforts single-service at the OSD level, perhaps using as a model the Office of Naval Research. The 6.2 programs have long supported the service labs at a level of about $3 billion a year.

Now there are discussions to achieve real consolidations using single centers of excellence serving all services. One possibility is to give DARPA responsibility for all 6.2 efforts and to operate the labs as Government-Owned, Contractor-Operated (GOCO) facilities in a manner similar to the operation of Department of Energy (DOE) national labs.

Project Reliance, a tri-service effort of several years standing, aimed at lab consolidation, may be rejuvenated as the services try to protect R&D interest from expanding DDR&E direction and control. Finally, 6.3A advanced development is the program level at which industry principally participates with roughly 85 percent of program funds contracted to industry. Overall, about 50 percent of the S&T $6 to $7 billion annual budget exclusive of SDIO is contracted to industry.

Bentley noted several other consequences of the new S&T strategy. Budgets for 6.3A programs are very likely to increase as DDR&E attempts to use ATDs in an ever-expanding way. As a consequence, 6.3B demonstration/validation will be reduced in scope and duration by risk reduction efforts in 6.3A. Funding for 6.2 exploratory development programs may well be squeezed as dollars are transferred to the expanding 6.3A account.

More of the 6.2 programs will be shaped by the thrust and DDR&E has organized 11 key technologies (replacing last year's set of 21 critical technologies) related to technology needs of each thrust. Finally, the emphasis on technologies supporting top-down needs means that technology-push or technology breakthrough research efforts will be curtailed.

CONFERENCES

Upcoming Conferences

• The 47th meeting of the Mechanical Failures Prevention Group will be held April 13-15 in Virginia Beach, VA. The theme of the conference is "The Systems Engineering Approach to Mechanical Failure Prevention." It is sponsored by the Office of Naval Research, the U.S. Army Research Laboratory, the Naval Civil Engineering Laboratory, and the Vibration Institute. Topics of discussion will include nondestructive evaluation and information processing, failure mechanisms and life extension, concurrent engineering for mechanical systems and condition-based maintenance systems engineering. Additional information may be obtained by writing Henry C. Pusey, executive secretary 4193 Sudley Road, Haymarket, VA 22069, or by calling (703) 754-2234.

• The Government/Industry Solutions for Obsolescence (Diminishing Manufacturing Sources and Materiel Shortages) Symposium will be held June 7-9, 1993 in Charleston, SC. It is sponsored by the Office of the Assistant Secretary of Defense, Production and Logistics, and is hosted by the Naval Supply Systems Command. The American Defense Preparedness Association (ADPA) is also providing support.

The objectives of the symposium are: to provide a government/industry forum to communicate innovative obsolescence solutions; provide a summary or several government and industry programs or initiatives currently underway that will minimize obsolescence in the future; and provide an opportunity for non-DOD organizations and industry to offer their innovative solutions. For additional information, write COL Baker, ADPA, 2101 Wilson Boulevard, Suite 400, Arlington, VA 22201-3061, or call (703) 522-1820.

AWARDS

Award Recipients Named

The following Army Acquisition Corps personnel are recent recipients of key awards. *Army Acquisition Executive Support Agency:* COL John W. Holmes, Program Executive Office—Intelligence and Electronic Warfare, Legion of Merit (LOM); COL Arthur A. Armour, PEO—Aviation (PEO-AVN), LOM; LTC Tony L. Dedmond, PEO-AVN, Meritorious Service Medal (MSM); MAJ Thomas M. Duckworth, PEO-AVN, LOM; MAJ Robert A. Dowling, PEO—Armaments, Army Commendation Medal (ARCOM); MAJ Michael G. Simpson, PEO—Combat Support, ARCOM; MAJ Donald J. Burnett, PEO—Armored Systems Modernization (PEO-ASM), ARCOM; MAJ Robert S. Hoover, PEO-ASM, ARCOM; and LTC Charles D. Stunson (recently retired), Army Acquisition Executive Support Agency, LOM.

LETTERS

Dear Sir: (Richard E. Franseen)

I read your article (FAST) in the Nov-Dec 1992 issue of *Army Research, Development and Acquisition Bulletin.* I was impressed with the program and still am. However the picture of Steve Vinci holding a prototype of an M1 Tank Engine Analyzer made me wonder what was going on at TACOM.

In September 1985 I submitted a suggestion to the Army Suggestion Program for an M1 Engine Analyzer. In early 1984 while serving a tour in Germany I built my own M1 Engine Analyzer. I was a sergeant working in the motor pool and needed something quicker and easier than the STE/M1. So I developed, built, and tested my own design of an M1 engine analyzer. Like the one in the picture mine has three multitesters, a twelve position rotary switch, 24 test jacks, and a 10-foot cable with adapter to the ECU, all enclosed in a briefcase.

After a PCS move to Fort Knox, KY, I submitted my suggestion. After five months of waiting I received a reply. Basically I was told there was no need for a device such as mine, because STE/M1 could do everything.

It has been seven years since I built my analyzer and it still works fine. It has seen two trips to Germany and Desert Storm where it worked when STE/M1 would not.

I don't have a patent nor any other rights to the design. I just think it's ironic that the Army would pay some engineer to do what I did for free. I am enclosing a picture, copies of my suggestion and the reply.

Sincerely,
George W. McNees
SFC U.S. Army

Army RD&A Bulletin Responds: Thank you for your inciteful letter. We have forwarded it to Richard Franseen and will publish his comments in our May–June issue.

Reinventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector

By David Osborne and Ted Gaebler, Addison-Wesley Publishing Company, Reading, PA, (1992).

Reviewed by CPT Thomas B. Gilbert, a member of the Army Acquisition Corps attending Oregon State University in the Master of Business Administration (M.B.A.) Program. He has been a frequent contributor to Army RD&A Bulletin.

Well, here it is. A book with the title that would chill any bureaucrat's soul. But be prepared for a surprise! This is not another one of your hysterical tomes capitalizing on the popular "damn the government and throw the bums out" theme. Far from this extreme, it takes an objective look at the system, challenges, and possible solutions. It is a constructive book presented in a non-critical and optimistically positive vein. The authors even tout several agencies within the Department of the Defense as leaders in revitalizing the federal system.

The authors have delineated their concepts into 10 principles of government improvement. In the context of this review, government can be construed to be a federal agency, military installation, state government, or local council. Briefly, these principles are:

1. The Catalytic Government - Steering Rather than Rowing.

American government, at all levels, has a tendency to accept too many functions onto itself. This has led to a well-intentioned effort becoming inefficient and expensive. The thrust of the thesis here is that government agencies are formed to implement or control a process—not to perform the job itself. The authors cite several Department of Defense initiatives attempting to turn this around, reduce costs, and increase productivity.

2. Community Owned Government - Empowering Rather than Serving.

This section is geared toward the social aspects of government, but it has a strong message on defining who the customer is and tenets on empowering the customer. In the past, budget cuts were achieved by reducing services or capabilities. With current demands, that can no longer be considered a viable alternative.

3. Competitive Government - Injecting Competition.

A government that promotes competition (between contractors and among internal departments) is achieving greater efficiency and reduced costs. Increased competition will reward innovative responses whereas a government monopoly will stifle initiative. Areas of focus were procurement, contracting, and creating competition for services within the government.

4. Mission Driven Government - Transforming Rule-Driven Organizations.

The authors quote General George S. Patton, "Never tell people how to do things. Tell them what you want them to achieve and they will surprise you with their ingenuity." The military is cited often as leaders in this quest for increased efficiency.

A mission driven organization is one that encourages personnel to seek efficiency and permits the freedom to make mistakes. Mission-driven agencies are: more efficient, innovative, and effective; produce better results; exhibit organizational flexibility and have higher morale than rule-driven organizations.

An example of a mission-driven budget system is provided. The advantages of this system are obtained through employee empowered incentives (not to be confused with blatant cash give-aways), managerial autonomy, simplified budgets, and reduced auditing requirements.

5. Results-Oriented Government - Funding Outcomes, Not Inputs.

All too often agencies focus their efforts on artificial indicators of job performance. The authors provide several sections that illustrate these key points. Some of the most thought provoking are quoted below:

"What gets measured is what gets done.

If you don't measure results, you can't tell success from failure.

If you can't see success, you can't reward it.

If you can't reward success, you're probably rewarding failure.

If you can't see success, you can't learn from it.

If you can't recognize failure, you can't correct it."

6. Customer-Driven Government - Meeting the Needs of the Customer, Not the Bureaucracy.

This section outlines several governmental approaches toward implementing Total Quality Management (TQM) systems. The key again is defining who the customers are (there are always more than one) and funnelling energy into the greatest fulfillment of the customer's needs.

7. Enterprising Government - Earning Rather than Spending.

It is almost anathema for the government to look at the profit motive—we are too accustomed to spending without the need to generate revenue. Many concepts discussed are applicable to procurement, installation or depot management, surplus reutilization, and contracting.

8. Anticipatory Government - Prevention Rather than Cure.

Long-term effects of current decisions are discussed, among which are the implications of accepting reduced costs now - in lieu of heavier future costs. An examination of the cost incentive dilemma explores the need for considering the total cost of a decision, and not just in the short run.

9. Decentralized Government - From Hierarchy to Participation and Teamwork.

The need for further decentralization of decision-making is promoted through analysis of actual case studies depicting increased savings, efficiency, innovation, morale, and productivity. Here again the military, specifically the Air Force, is complimented on their successful strides in this case effort.

Flattening the organizational hierarchy is becoming a favorite theme (by the way, I can't wait for the new book on the subject by Tom Peters, the "Excellence" guru, due out soon). Teamwork within a participatory environment has apparently been very successful, but it takes a dynamic, self-confident, and secure leader at the top for it to be successful.

10. Market-Oriented Government - Leveraging Change Through the Market.

Here the authors hit conventional program management—and hit it pretty hard. In all honesty, the authors made good points on the topic. Anyone working with military programs can read this chapter and understand the salient truth behind the issue. Several potential solutions are presented that are worth contemplating.

As professionals dealing with military RD&A, we must not only design our systems to be effective, but we need continuous improvement within our organizational structures and processes to capitalize on our increasingly scarce resources. Our way of doing business must reflect cognizance and adaptability to the economic reality of our times. The book provides either a starting or turning point. All we need to do is adapt the principles in the way that best fits our organizational needs.

The authors have offered a new paradigm through which to view our government and it's evolving environment. We all agree that a change is taking place, but few of us will accurately predict the composition of the military RD&A community even 10 years from now.

By using the principles placed forth in this book, we may grasp a better understanding of emerging requirements and use available resources to best serve our ultimate customer—the soldier on the ground doing his job. He doesn't care what our petty organizational problems are, he just knows what he needs and when. Compared to his sacrifice, anticipating organizational processes and maximizing our opportunities is not much to ask.

Bulls Eye, The Assassination and Life of Supergun Inventor Gerald Bull

By James Adams, Times Books, 1992

Reviewed by Joe Sites, a retired Army colonel who spent 30 years in the Field Artillery. Since his retirement he has worked as a consultant and is currently employed by BRTRC of Vienna, VA. If there are readers of this review who had contact with Gerald Bull or who have information on his work, and would like to share this information, please contact Joe Sites at (703)938-2014.

Gerald Bull's career in the defense industry can best be compared to a Greek tragedy. He was an absolute genius in the field of weapons' design. Products of his genius were the High Altitude Research Program (HARP) in which a gun he designed fired a projectile to an altitude of 112 miles; artillery pieces declared to be the best in the world; and unique concepts which have been incorporated into the Copperhead munition and Space Defense Initiative research. Despite his ability and genius, Bull ran into road blocks throughout his career. Instead of ending his life as a world famous inventor, he was assassinated by unknown forces who considered him a threat. The Western world, at least publicly, appeared to have little interest in clearing up the mystery of his death.

His original homeland, Canada, vacillated in its recognition of the need for his contributions, while the United States, his adopted homeland, placed many obstacles in the path of his work. Some of the U.S. obstacles resulted from interservice rivalries; others came from the Not Invented Here Syndrome. This caused the support of the United States to be an on-again, off-again affair. This support was insufficient to keep Bull going.

As a last resort, Bull became involved in questionable foreign sales which may have had the tacit approval of the United States. The author strongly indicates that as a result of a change in its foreign policy, the U.S. government took a second look at Bull's questionable business, declared it illegal, took him to court and sentenced him to jail. Bull considered this a betrayal. He then departed from the company of legitimate enterprises and began to work for anyone who would pay him. This included the government of Iraq.

His work for Iraq in developing artillery, long range guns, and rockets was extremely successful and has been well publicized. If Bull had not been killed in 1989, he most likely would have made even greater contributions to Sadam's war machine.

For those of us who have devoted much of our working lives to our defense establishment, it is a real tragedy to see how little our military profited from the great opportunities which could have been ours had we taken advantage of our connections with Bull. The author, on the other hand, sees that Bull's life should make people aware of the evils of the armaments industry. In fact, Adams stresses this point to the extent that he neglects providing details on Bull's life and work. It could be that the author did not have more material which was pertinent and stretched what he had.

This book is interesting for those who are involved in weapons and the Army. It makes references to the Army Materiel Command, Missile Command, Ballistics Research Laboratory, and Picatinny Arsenal as well as several other members of the AMC community. As with many hot-off-the-press accounts of recent events, this book suffers from being too close in time to the events it is relating. It is disappointedly lacking in technical details of Bull's inventions and the chronology of events is often difficult to follow.

Bulls Eye is recommended not as a book, but rather for the story. The book could be very constructive if it had some influence on insuring that the potential of future geniuses gets a better hearing than that afforded Gerald Bull.

The Learning Curve Deskbook: A Reference Guide to Theory, Calculations, and Applications

By Charles J. Teplitz
Quorum Books, Westport, Connecticut, 1991

Reviewed by MAJ John N. Lawless Jr., who holds an M.S. degree in acquisition and contract management from the U.S. Naval Postgraduate School. He is currently participating in the Training with Industry Program at the Sikorsky Aircraft Company, Stratford, CT.

In an era of shrinking defense dollars, program stretchouts, and "best value" contracting, it is especially important that acquisition professionals remain proficient in their use of cost prediction and cost control techniques. One of the most powerful and dynamic of these techniques, the learning curve theory, is used to predict the increase in performance efficiency which results from the execution of repetitive tasks. *The Learning Curve Deskbook* is a clear, succinct handbook which will provide both the technical and non-technical reader with a fundamental background of basic learning curve theory, as well as an intelligible, ready reference of frequently used models, tables, and formulas.

Dr. Teplitz introduces the reader to the learning effect by examining the work of T.P. Wright during the 1920s. Wright, who observed the effects of learning on the construction of small aircraft, noted that as the production quantity doubled, the average labor cost per aircraft decreased by a constant rate. The doubling effect as described by Wright later became known as the Cumulative Average Theory. A variation of this theory, the Unit Learning Curve Theory, was observed by J.R. Crawford during the 1940s. Crawford's model noted constant improvement in actual unit costs rather than cumulative average costs. Many subsequent refinements to these two basic models have since been developed.

The author notes that while learning curves have been

used in many industries for dozens of years, people still tend to identify them with the airframe industry or mass manufacturing. He lists sample industries using learning curves, including such seemingly unlikely applications as clerical operations and potato chip manufacturing. With the ever-increasing emphasis on controlling costs and improving productivity, learning curve usage continues to spread to even more diverse fields.

Following his discussion of basic learning curve theory and a comparison of the most frequently used models, Dr. Teplitz provides a list of equations, techniques, and supplemental theorems for determining learning rates which can be assumed in various situations, depending upon the type of data available. For example, in the absence of actual observations, estimating procedures such as historical analogy, industry standards, and labor vs. machine intensity can be used to develop an initial approximation of the rate of learning. As actual data becomes available, the estimate can be refined and the model updated.

The main body of the text, which will likely be of the greatest use to the typical reader, contains more than 50 equations for estimating resource requirements for an abundance of situations. These equations are accompanied by illustrative examples to show the correct application of the learning curve theory, as well as solutions to problems which may arise.

Subsequent chapters examine the application of more complex learning curve models, many of which have been adapted for use in unique situations, together with enhancements for better control of learning curves. The final chapter examines limitations on the uses of learning curves, together with some precautions in applying learning curves to "real world" situations. The handbook also features over 120 pages of appendixes containing formula summaries, detailed learning curve tables, and an extensive bibliography of articles and publications describing the evolution and use of learning curves over the past 50 years.

The Learning Curve Deskbook is a balanced, useful text which places a complicated theory within the grasp of laymen, yet it provides extensive resources for the experienced practitioner. As the use of learning curves continues to spread to new industries, technicians and managers alike will be well served to acquaint themselves with this valuable reference guide.

Superintendent of Documents **Subscriptions** Order Form

Order Processing Code:
* 5190

☐ **YES,** enter my subscription as follows: **To fax your orders (202) 512-2233**

____ subscriptions to **ARMY RD&A BULLETIN (ARAB)** for $7.50 per year ($9.40 foreign).

The total cost of my order is $_____. Price includes regular domestic postage and handling and is subject to change.

(Company or Personal Name) (Please type or print)

(Additional address/attention line

(Street address)

(City, State, ZIP Code)

(Daytime phone including area code)

(Purchase Order No.)

May we make your name/address available to other mailers? YES ☐ NO ☐

Please Choose Method of Payment:

☐ Check Payable to the Superintendent of Documents

☐ GPO Deposit Account ☐☐☐☐☐☐☐ — ☐

☐ VISA or MasterCard Account

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐ (Credit card expiration date) ***Thank you for your order!***

(Authorizing Signature) 12/91

Mail To: New Orders, Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250-7954

ARMY
Research
Development
Acquisition
RD&A
BULLETIN
Professional Bulletin of the RD&A Community

WRITER'S GUIDELINES

ABOUT THE BULLETIN: Army RD&A Bulletin is a bimonthly professional development bulletin published by the Army Acquisition Executive Support Agency, an element of the Office of the Assistant Secretary of the Army (Research, Development and Acquisition). The bulletin's editorial office is located at Building 201, STOP 889, Fort Belvoir, VA 22060-5889. Phone numbers are Commercial (703)805-4215/4216/4046 or DSN 655-4215/4216/4046. Datafax (703)805-4044.

PURPOSE: To instruct members of the RD&A community relative to RD&A processes, procedures, techniques and management philosophy and to disseminate other information pertinent to the professional development of the RD&A community.

SUBJECT MATTER: Subjects of articles may include, but may not be necessarily limited to, policy guidance, program accomplishments, state-of-the-art technology/systems developments, career management information, and management philosophy/techniques. Acronyms should be kept to an absolute minimum and when used, must be written out and explained.

LENGTH OF ARTICLES: Articles should be approximately 1,500 to 1,800 words in length. This equates to 8-9 double-spaced typed pages, using a 20-line page.

PHOTOS: Include any photographs or illustrations which complement the article. Black and white or color are acceptable. We cannot promise to use all photos or illustrations and they are normally not returned unless requested.

BIOGRAPHICAL SKETCH: Include a short biographical sketch of the author/s. This should include the author's educational background and current position.

CLEARANCE: All articles must be cleared by the author's security/OPSEC office and public affairs office prior to submission. The cover letter accompanying the article must state that these clearances have been obtained and that the article has command approval for open publication.

Authors should include their address and office phone number (DSN/autovon and commercial) when articles are submitted.

In addition to printed copy, authors should submit articles on a 5 1/4-inch floppy disk in ASCII format.

Army RD&A Bulletin
Building 201, STOP 889
Fort Belvoir, VA 22060-5889

Commercial: (703)805-4215/4216/4046
DSN: 655-4215/4216/4046
Datafax: (703)805-4044

UNIVERSITY OF FLORIDA
3 1262 09682 7778

ARMY RD&A BULLETIN
ISSN 0892-8657

Army RD&A Bulletin
Building 201, Stop 889
Fort Belvoir, VA 22060-5889

SECOND CLASS
POSTAGE PAID
AT FORT BELVOIR, VA
(and Additional Offices)

